Sculpt 3D

AMIGA SOFTWARE
PAL VERSION

BYTE by BYTE™
CORPORATION

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ADDENDA

We couldn't resist. We've added some new features to SCULPT 3-D since the manual was typeset. We have also improved the function of some of the features. Please note the following changes, additions, and corrections. Also please note that SCULPT 3-D will only work with version 1.2 Kickstart/Workbench.

ADDITIONAL FEATURES IN SCULPT 3-D

Menu Bar Status Readout

The menu bar now has a status readout that looks like this:

MEM(C+F)=30000+40000 V=0 E=0 F=0 L=0

MEM(C+F)= give you the free Chip and Fast RAM available currently on your Amiga.

V= counts the current number of Vertices.
E= counts the current number of Edges.
F= counts the current number of Faces.
L= counts the current number of Lamps.

The status readout can be toggled on/off using the F10 function key. The default is status display off. See below for the action of other function keys.

You will also find an additional item in the status display when you start rendering an image. A timer will appear displaying the time required to render your image. The timer will count down during the image creation process, displaying the remaining time until the completion of your image. The timer is not very accurate, and is provided just to give you a rough gauge.

Function Keys

Each of the function keys have now been assigned an action.

F1	Load scene	F6	Save object
F2	Load image	F7	Batch
F3	Load object	F8	Observer start
F4	Save scene	F9	Observer show
F5	Save image	F10	Toggle Status Display

Keyboard Equivalent Commands

We have added several keyboard equivalents to menu functions. These keyboard equivalents are accessed by holding down the right Amiga key and pressing the letter corresponding to the desired action.

Right Amiga + C - Modify color of selected faces
Right Amiga + T - Modify texture of selected faces
Right Amiga + S - Modify smoothing of selected faces
Right Amiga + L - Create lamp
Right Amiga + O - Observer location

One additional keyboard driven command has been added. Pressing the Escape key repeats the last menu command. An example of using this command is the Erase Indicated Vertex command. Point at a vertex and erase it using the menu command. By pointing at additional vertices and pressing the escape key you can erase additional vertices easily.

Ground and Sky

Paint mode now supports Ground and Sky selection. This will give you a much better perspective on the position of the horizon to your scene. The Checkered background mode is not supported in Paint mode. The Ground and Sky are shown as a solid color only.

Glass Texture

You will find a new texture in the Edit Texture menu called Glass. This simulates the appearance of glass. Its ratio of reflection/transmission will change as the angle of the observer to the plane of its surface increases. When the observer is perpendicular the ratio is about 80% transmission, 20% reflection. This will slowly go up to 100% reflection as the angle becomes oblique. Think of standing in front of a window. You can see through it although you also see a slight reflection as well. As you move to one side it becomes harder to see through the window, and the reflections become more intense.

Wire Frame Mode

There is a new Observer Mode called Wire Frame. This will create a wire frame rendering in perspective of your scene. It is very fast, and only renders edges. The colors are not adjustable. A horizon line is drawn in wire frame mode if ground is turned on and the observer is not at ground level.

Miscellaneous Additions

You can now abort either Batch mode or Script mode by pressing CTRL-C.You can blank the screen during rendering by double clicking the left mouse button on the image screen. Clicking the right mouse button will restore the image. This will speed up image rendering.

RUNNING SCULPT 3-D ON A 512K AMIGA

SCULPT 3-D is a large program, and creating HAM images requires lots of memory. SCULPT 3-D will run on a 512K Amiga, but it will run more efficiently with additional memory. When you run SCULPT 3-D, the program checks for the presence of additional memory. If it does not find any, only part of the program is loaded into memory. Special purpose modules are stored on the program disk and loaded into memory only when needed. If you have removed the program disk from the drive the program will prompt you to put the program disk back when it needs these additional modules. If you have additional memory the entire program will load. As you create a scene the vertices, edges, faces, and lamps use up memory. If you get close to running out of memory, SCULPT 3-D will discard some of the special purpose modules from memory to free up additional space in memory. This may result in the program requesting the program disk at some point when you attempt to use a function that requires one of these special purpose modules.

SCULPT 3-D will also not let you render an image in a resolution mode that will require more memory than is available on your system. Check to see if you have other programs running, or other windows open in Workbench. Closing open windows or exiting other programs will free up additional memory. You may also choose to run SCULPT 3-D from the CLI without loading Workbench. This will free up approximately 40K of memory. See the book that came with your Amiga, "Introduction to Amiga" for information on creating a CLI boot disk. You will also need to use the CLI command STACK to manually set the stack to 10,000. To do so type STACK 10,000 from the same CLI window that you will run SCULPT 3-D from. If you have at least 1 megabyte of RAM, set your stack to at least 30,000.

Additional memory can also be manually freed up by pressing "Control-M". In most cases this will delete your Workbench scene. If this occurs, don't panic, since the Workbench Screen will reappear when you exit SCULPT 3-D. The status display will change if memory was freed. Note than if more than 300K is free, then the code that was unloaded will be immediately reloaded.

CHANGES TO SCULPT 3-D

ERASE ALL now removes the GROUND. SKY is not removed.

The Extrude tool no longer does a fill automatically. You will have to use the Fill tool to create filled extrudes.

The Fill tool will now work on just the selected vertices of an object as long as they constitute a closed loop. This lets you fill part of an object.

The Bit Plane toggle in the Observer menu has been changed. The minimum number of bit planes is 2, giving 4 colors. Do not type "0" or "1". The default value is now 6. This is HAM mode. If you select a value larger than 6 you will be prompted to supply file names for three files; the RED, GREEN, and BLUE components of the image. You will also be asked for the relative size of the horizontal and vertical scale of a pixel (whole numbers only) and the screen width and height in pixels. See the manual for your brand of frame buffer for this information. If you do not own a frame buffer do not use a Bit Plane value larger than 6.

After the initial phase of painting mode, the grinding gears vanish and multi-tasking is enabled. A timer is displayed. The painting can be aborted with ABORT or CONTROL-C.

HINTS AND TIPS

We've got a few additional suggestions for getting the most out of SCULPT 3-D. Some of these are ways to make creating images easier and a few will speed up the rendering of images.

When you create a scene use the smallest possible number of vertices. Every additional vertex adds to the rendering time. A few possible places to look at for removing vertices are the intersections of two objects, the inside of objects you will never enter, the backside of objects you will never see (unless they contribute to a shadow), and any points on intersecting solids that are not needed. Intersecting solids have a strong negative effect on rendering times. Remember that it is better to use smoothing to make an image look smooth than to use sub-divide as sub-divide uses up much more additional memory than smoothing.

You should also take a close look at all objects that enclose a volume. Whenever possible close the surface of such objects. Although it may appear that doing so adds to the count of vertices, edges, etc., the net result is that your scenes will render faster, and require less memory for the pre-rendering calculations.

The same strategy applies to the placement of lamps. Most scenes will require only one or two lamps. Avoid placing large numbers of lamps whenever possible as this will greatly increase the rendering time of your scene. As a general rule, lamps should be placed at a distance equal to at least five time the width of the largest object in the Tri-View.

The observer should also be placed at a greater distance than you might initially expect. If you place the observer too close you will only see a solid wall of color from a single object. Start further away, and if necessary move the observer closer in steps. Also remember to place your target at the point you want to be looking at. A misplaced target can give the impression of incorrect observer or lens selection.

The expand and contract Tri-View gadgets have a total of thirty-six steps between them. It is possible to "bump" up against the limit of expansion or contraction. You will see a notice if this happens. You may also find that you lose sight of a particular object when you contract the Tri-View. To keep your desired object in view, place the cursor in the center of the object and click on the center Tri-View gadget. This will move the Tri-View so that your object is in the center of the window. You may want to do this in two Tri-View windows before contracting the Tri-View.

You may also want to move the rendering screen to the back of the Tri-View screen during rendering. This will speed up rendering on 512K Amigas. If you are using Jumbo image size and first push the image screen to back and then bring it forward using the back/front gadgets at the upper right of the SCULPT 3-D screen the image will appear clipped at the borders. Use the observer show command instead to bring it to front and this will not happen. This is a result of a bug in Workbench 1.2.

If you have moved the rendering screen to the back and start working on a new scene you may find that the response time shows a significant decrease. This is an unavoidable result of multi-tasking. Ray tracing requires massive amounts of number crunching, and this puts a heavy load on the CPU. Be patient.

Should you desire to use images created with SCULPT 3-D in other programs remember that SCULPT 3-D adds a suffix ".image" to all image files. If your program requires a different suffix, you will need to rename your image files. SCULPT 3-D will not recognize files that do not have the correct suffixes attached.

SCULPT 3-D supports multi-tasking. A side effect of this is should your Amiga put up a System alert such as a request to replace a particular disk it will push the SCULPT 3-D screen to the back to do so. In most cases responding to the alert will bring the SCULPT 3-D screen back. Occasionally this may not occur. Clicking on the front/back gadget at the upper right of the screen will restore the SCULPT 3-D screen to the front.

EXAMPLE SCRIPT FILE

Script files are extremely useful for generating images in a batch-type environment. Although a batch mode is provided for Sculpt 3-D, it is limited to processing 14 scenes at a stretch. Also, in batch mode, images must be saved from the same place that their associated scenes come from. Script files offer an incredible flexibility in non-interactive processing.

Let's set up the following scenario. You need to process two scenes on two different drives on your system. Cup1.scene is the first scene and it is in drive "df0:". Cup2.scene the second scene and it is in "df1:". To create the script file necessary to process these two scenes, you would need to enter the CLI (Command Line Interpreter, see your AmigaDOS manual) and create a script file. "Ed" is a full screen editor provided on every Amiga Workbench and it is documented in the AmigaDOS manual. If you are unfamiliar with "Ed", then please consult your AmigaDOS manual before continuing.

Our script file has to have a name. Sculpt expects script files to have a ".script" on the end of every script file. Let's call our script file "example.script".

Enter "Ed" and enter the following:

```
ERASE ALL
LOAD SCENE "df0:Cup1.scene" LAMPS OBSERVER WORLD OBJECTS
START
SAVE IMAGE "df0:Cup1.image"
ERASE ALL
LOAD SCENE "df1:Cup2.scene" LAMPS OBSERVER WORLD OBJECTS
START
SAVE IMAGE "df1:Cup2.image"
ERASE ALL
QUIT
```

The above script file will load the first scene, process it, and then save out the image created. After the first scene is completed, the second one will begin processing. Sculpt will terminate at the end of processing scene 2.

To use the above script file, enter Sculpt and select PROJECT-LOAD-SCRIPT from the menu. Type the path to the script file in the drawer gadget and press return. The contents of the path should appear in the scroll area of the load script requester. "example" should be one of the scripts listed. Select the filename with the mouse and click "OK". The script should load and begin executing. If you made any errors, Sculpt will pause processing, list the error in the script, and ask you to continue or cancel. Since you may not be there to answer such a request, you need to be very careful in creating your scripts.

PRINTING AN IMAGE FROM SCULPT 3-D

Images from Sculpt 3-D may be printed out on a graphics printer using the GraphicDump utility on the Enhancer 1.2 Workbench disk. Here's how:

1. Be sure that your printer is properly connected to your Amiga. Ask your dealer about cable requirements, and be sure to read the warnings in your "Introduction to Amiga" manual.

2. Call up Preferences and use the Change Printer option to set up the Amiga for your printer. The Amiga manual describes Preferences if you need more detail. However, important options

are: which printer you want to use; which port (parallel or serial) it is connected to; margin settings (which will determine the maximum image width); and graphics settings. In the Graphics Select screen, you should select a Gray Scale or Color shade (depending on your printer) and a Positive image. The aspect setting MUST be set to Horizontal, otherwise Sculpt's Hold-And-Modify (HAM) images will not print out.

Note: Sculpt's HAM mode images will not print out properly using system software older than the Enhancer version of 1.2 Workbench.

3. With the printer set up properly, go to Sculpt and call up the image you want to print.

Note: Read the next TWO steps before proceeding further.

4. Press Left Amiga-N to call up the Workbench screen and find the icon for the GraphicDump program (it should be in the Workbench:System drawer). Double-click the GraphicDump icon.

5. Now you are on the clock. You have 10 seconds to push back the Workbench and Sculpt 3-D screens and get your desired image "on top" (in front of all other screens). You can use the depth-arranger gadgets or the Left Amiga-M to do this. After 10 seconds GraphicDump will start printing the topmost screen.

Notes:

--The printout will take a while. The only way we know to abort GraphicDump is to take the printer off-line and wait for a "Printer Trouble" requester (about 1 minute), then select "Cancel". This might not work with some cabling arrangements.

--Once the print starts, you may push back the screen being printed and use programs running in other screens.

--The GraphicDump program will print out any Amiga screen, not just Sculpt 3-D images.

--This procedure has been tested using an Amiga 1000 with a Diablo C-150 printer connected to the parallel port. It worked very nicely, but of course other configurations can (and will) vary in performance.

FOREWORD

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We also believe in keeping software prices low. SCULPT 3-D could have been priced hundreds of dollars higher, programs with similar functions on other computers sell in that range. We want everyone who wants to own a copy of SCULPT 3-D to be able to. That's why this program has a list price under $100 dollars. Low priced software (we hope) will remove some of the incentive for software piracy. To keep the price low we have 'unbundled support' for this program. This means if you want to call us with technical questions you will first have to purchase a support option. This is a new concept in consumer software although it has existed in business software for quite some time. Please see the enclosed support program options list for more information. We believe you will find answers to most of your questions in this manual, read it before you call us, it will save you money and time.

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Printed in the United States of America
by Whitley Company

INTRODUCTION

What is SCULPT 3-D?

SCULPT 3-D is an interactive solid modelling editor, combined with ray tracing software to generate realistic full color images.

This means that you can use SCULPT 3-D to construct a computer simulation of any solid shapes that your mind can conceive, and then see what they would look like by displaying their image on the computer screen. You don't have to be a mathematician, or know anything about 3 dimensional geometry to use SCULPT 3-D. Any shape can be formed and manipulated with the aid of the mouse and its two buttons.

Think of SCULPT 3-D as the next step beyond a Paint program. A paint program enables you to daub simulated pigments on the screen of your display without having to learn the intricacies of how paints interact, and without the hazard of messing up your best shirt. To use a Paint program effectively does require a modicum of creative skill, particularly if you are trying to produce a naturalistic scene.

SCULPT 3-D takes care of many more details than a Paint program, like shading, shadows and perspective. In fact, making an image with SCULPT 3-D is very much like taking a photograph, just point and shoot and out comes a picture. Even when you are using SCULPT 3-D to build a solid object, the construction is much easier than with any real construction medium. You can save your intermediate stages, so if you make a mistake you can quickly backtrack.

Software packages like SCULPT 3-D have been readily available for some time. What makes SCULPT 3-D unique, besides its extra simple interface is that the other packages cost about one hundred times as much and require hardware that costs a hundred times more than an Amiga.

What is the catch? Well, SCULPT 3-D can only display an image within the constraints of the Amiga hardware. It can never generate an image as detailed as those seen in the movie "Tron". Similarly, because the Amiga is not a Super-Computer, some tasks that SCULPT 3-D can perform will take a while. A full screen, ray traced image of hundreds of objects may take many hours to generate. However, SCULPT 3-D provides several ways to get quickie previews of what the final image will look like in only a minute or two. Does your Amiga really work 24 hours a day? Now your Amiga can be doing useful work while you are asleep, or away at the office.

When you use SCULPT 3-D, you are really building a private universe. Once you have finished construction, you can roam your imaginary world and take pictures from any viewpoint and in any direction.

We have been emphasizing SCULPT 3-D as a recreational and artistic tool, however it is by no means limited to this role. If your business or profession involves the construction of physical objects, be they cities, buildings, vehicles, toasters or coffee mugs, then you can use SCULPT 3-D to see what your design is like before you commit money to physical production. For some professions, like videography, an image is a final product, so SCULPT 3-D can take an even more central position.

No special skills are needed to operate SCULPT 3-D. You can take a picture at any time, to see if your 3 dimensional objects are the way that you want them. This book will lead you through all the stages of solid modelling and image generation. Unlike many programs, you can start getting useful results from SCULPT 3-D with a minimum of training. In a few pages you will be told how to generate your first picture, and by the time you have finished the book, there will no scene that you cannot create.

CHAPTER 1

This chapter introduces you to the operation of SCULPT 3-D. You will be shown how to load a scene from the disk, generate a picture of the scene and finally save the picture on the disk.

Getting Started

If you have already used a few Amiga software packages you can probably skip this section, after you have made a backup copy of the SCULPT 3-D distribution disk. If you are new to the Amiga, you should know that while floppy disks are very secure, accidents can happen, so it is wise to make a copy and keep the original disk in a safe place far from coffee spills, magnets and small animals.

The book "Introduction to Amiga", that came with your Amiga tells you how to make a backup copy. When this important step is complete, you are ready to start using SCULPT 3-D.

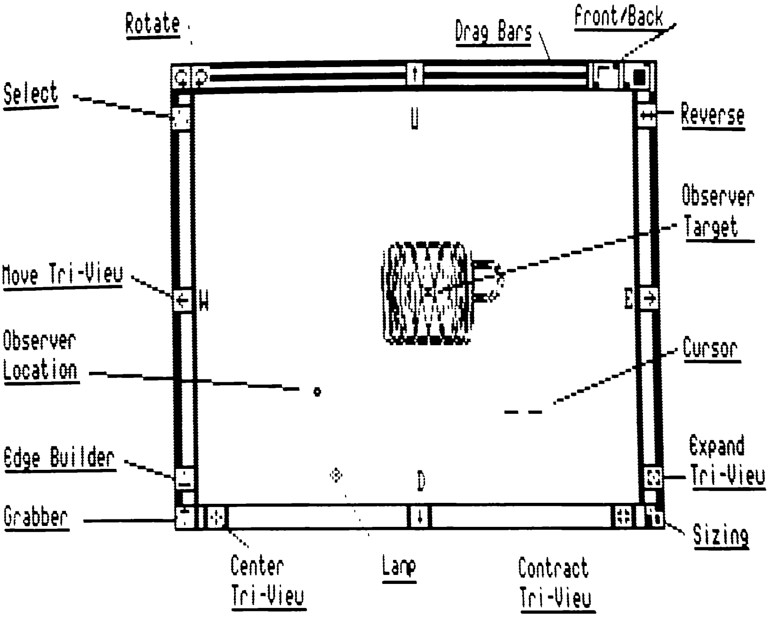
The program can be started from Workbench by double clicking on the icon for the SCULPT 3-D disk. Then double click on the SCULPT 3-D icon. Alternatively, if you are using the Command Line Interface (CLI), simply type "3D".

After a few moments of disk activity, SCULPT 3-D starts by displaying three brown windows, these are collectively known as the Tri-View.

The Tri-View

The Tri-View is necessary because the Amiga can only display flat images on the screen, while SCULPT 3-D works with three dimensional solid objects. The three windows show three different views of a rectangular chunk of space. Initially each window is empty except for a little blue cross in the center, and four letters denoting the cardinal directions.

The window at the upper left is a view looking downward, like a map, with north at the top, west to the left, etc. The title of the window, in this case 'DOWN', is displayed in the top border, to remind you which way you are looking. The window below shows a view looking northward, so west is to the left and up is towards the top of the screen. Its title is 'NORTH'. The third window, at the lower right of the screen is a view looking west with south to the left and north to the right of the screen. Not surprisingly, this window is entitled 'WEST'. When we refer to a window of the Tri-View, we will use the window title.



The Tri-View

If you have ever encountered technical drawings, or blueprints of a house, you will be familiar with this way of representing solid objects. As with most Amiga software, these windows may be moved around on the screen in any way that you wish. To move a window, use the mouse to position the pointer anywhere on the Drag Bar on the top of the window. Hold down the left button on the mouse and when you move the mouse, a ghostly outline of the window can be moved. When the button is released the window will be refreshed at its new position. It is up to you, where you place the windows.

The size of a window can be easily changed by using the sizing gadget that can be found at the bottom right corner of each window. To change the size of a window, point to the sizing gadget and hold down the left mouse button while you drag the corner of the window to create a new shape or size. When you release the button, the window is refreshed, but you may notice that something funny happens. Whenever you change the size of one window, one or both of the other windows will change also. This is because the windows represent a rectangular chunk of empty space. Suppose that you reduced the size of the chunk at its south end, then the change would be seen in the view looking down as well as in the view looking west.

If your windows overlap one another, you can use the back gadget or the front gadget to change the depth arrangement of the windows. As usual with Amiga programs, these gadgets may be found at the right hand end of the top border. To use them, point to the gadget and press the left mouse button.

SCULPT 3-D cooperates fully with other Amiga software. You can run many different programs at the save time, if you have enough memory. This can lead to confusion, unless you have a clear idea of what is going on. The Amiga display is composed of screens and windows. Each screen can have windows associated with it. An example of a screen is the Workbench screen. SCULPT 3-D creates two screens, one for displaying the Tri-View and another for displaying images. These two screens, along with the Workbench screen and any other screens that you may have created can be depth arranged. Sometimes you may think that you have lost a screen, usually you will find it hidden behind other screens. Occasionally the Amiga operating system will display a requester demanding some action, such as inserting a disk, and it will push back the SCULPT 3-D screens. After you have answered the requester, it will look as if SCULPT 3-D has disappeared. Push back the Workbench screen and you should find that SCULPT 3-D is still running.

Each Tri-View window has more than a dozen extra gadgets tucked away in its borders. We will be describing each one in detail later in this book. To avoid confusion, try to restrain yourself from using the gadgets until you know what they are supposed to do. However, if you do feel adventurous, none of them will cause damage to your Amiga.

The blue cross in each window is called the cursor. It represents a position in three dimensional space. To move the cursor, use the mouse to point to a new position for the cursor, within a window, and press the left mouse button. The cursor will jump to the desired position. If you hold the left mouse button down, while moving the mouse, the pointer will vanish and the cursor will move. You will notice that you cannot move the cursor outside the window. You may also notice that when you move the cursor in one window, the cursors in the other windows also move. Because the mouse only works in two dimensions, you will usually have to move the cursor in two windows in order to locate a position in three dimensions. You will quickly become accustomed to switching windows in order to move the cursor around in three dimensions.

If the position of the cursor is correct in one window, say the west window, that means that the cursor is correct in the north-south direction and in the up-down direction. The cursor may not be in the correct position in the east-west direction. If the cursor also looks in the correct position in either of the other windows, then it must also be correct in the east-west direction. To position the cursor in three dimensions, move it to the correct position in two windows, and its position will always be correct in the third window.

The Menu

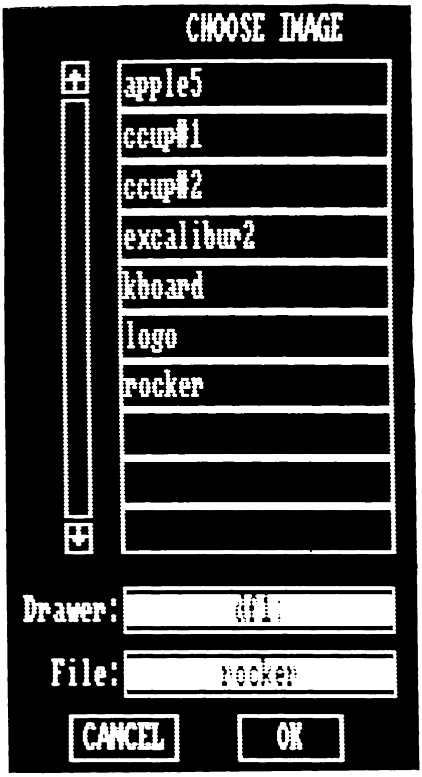
Most of the commands that you can issue to Sculpt 3-D are made through the menu system. To make the menus visible, press the right mouse button and hold it down. If nothing happens, move the pointer into one of the Tri-View windows, and click the left mouse button. Then try again with the right mouse button. The menus show up as a bar at the top of the screen as the words 'PROJECT', 'EDIT', 'TOOLS', 'OBSERVER' and 'WORLD'. To see more of the menu choices, move the pointer up to the desired word, keeping the right mouse button down all the while. When the pointer touches the word, a list of choices will spring down. To activate a choice, move the pointer to that item and release the right button. If you change your mind about executing a menu command, move the pointer away from the menu region before releasing the right mouse button. Be a little cautious about where and when you release the button, or you may execute a command unintentionally.

As you move the pointer down the list of menu choices, sometimes a set of auxiliary choices will pop up, just to the right. To execute one of these, move the pointer over to the one that you want and release the right button. Remember that the action only takes place when you release the right button when the pointer is over a menu choice.

Sometimes you may need to issue several commands from the menu, one after another. Rather than releasing the right button, and then having to wend your way through the menu system each time, there is a way of generating multiple commands. When the pointer is over the choice that you want, instead of releasing the right button, press the left mouse button. Still holding down the right button, move to the next choice and click the left button. You will quickly become proficient with this speedy way of using the menu system. It is called extended menu selection.

Loading an Image

To get an idea of the capabilities of SCULPT 3-D, take a look at some of the images on the SCULPT 3-D distribution disk. Hold down the right mouse button and point to the word PROJECT at the top left of the screen. Move down to the word LOAD, and then move to the right to the word SCENE. Finally move down to the word IMAGE and release the right button. You have issued the command PROJECT LOAD IMAGE.



Drawer: df1:

File: rocker

The Load Image Requester

If you have done this correctly, the menus will vanish and the pointer will be replaced by an image of grinding gear wheels. This indicates that SCULPT 3-D is busy and should not be disturbed. In this case it is looking through the disk to see if it can find any files that contain images. It recognizes image files by their ".image" suffix. You will notice that the disk drive light is turned on. After a few seconds, the normal pointer will return, and a new image will be displayed. It is called a requester. The requester is asking you to choose the name of an existing file that contains a SCULPT 3-D image. Files are displayed in sorted alphabetical order.

If your disk contains more than 10 images, you can use the the scroll gadgets at the left hand side of the requester to move through the list of choices. The tall vertical box is called a slider. To operate the slider, point to the white portion of the box, which is called the knob, and hold down the left mouse button. If you move the mouse, you can cause the knob to move up and down. The size of the knob, relative to the size of the slider box, indicates how many images are named on the screen compared to how many images are stored on the disk. If you move the knob to the bottom and release the left mouse button, the list of files will display the last 10 that were found on the disk. If the knob is moved to the top, the first 10 images will be shown. With the knob in the middle of the slider box, then the middle 10 image names are displayed. To move the displayed list up or down by one line, click on the arrow gadgets above or below the scroll slider.

If your disk contains 10 or fewer images the scroll gadgets have no effect, because all available images are displayed. To make a selection, point to the name that you want and click the left mouse button. The name will appear in the box called 'File'. If you change your mind, make another choice.

Advanced users may wish to click on the box called 'Drawer' to enter the name of another disk drive, or project drawer. After the name has been typed in, press the return key, and the list of image names will be replaced by a list of image names that exist in the drawer. If all the names vanish, you have either typed in the name of the drawer incorrectly, or the drawer does not contain any images.

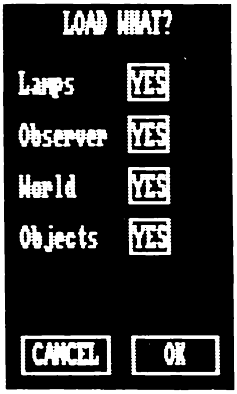
When the file box contains a name that looks interesting, click on the OK box with the left mouse button. The screen will clear and the image will appear one line at a time. When you wish to dispose of the picture, click first with the left mouse button, and then click with the right mouse button. This does not destroy the image, it pushes the screen containing the image behind all the other Amiga screens.

Loading a Scene

A scene is a collection of objects and lamps. A scene may also contain information about the observer and a description of the ground and sky. It will also contain information regarding the observer mode, lens, exposure and image size associated with that scene. Scenes are manipulated in the Tri-View and may be stored on disk. Your SCULPT 3- disk comes with some scenes, so let us try and load one of them.

Execute the menu command PROJECT LOAD SCENE. After a short pause, a requester will pop up that looks very much like the requester used to load images.

Scroll the list until you find a scene called "LITTLEHOUSE". Click on it, so that the name is transferred to the 'File' box. If you had decided not to bother loading a scene, you could click on CANCEL. Instead, click on OK, to indicate that you have made your choice, and that you still want to load a scene.



Lamps YES
Observer YES
World YES
Objects YES

The World "Load What" Requester

The file requester vanishes and is replaced by another requester, asking what it is that you wish to load. A scene may contain lamps, details about an observer, the world and some objects. Beside the name of each item is a box that can contain either the word 'YES' or 'NO'. Initially each box contains the word 'YES'. If you click on a box with the left mouse button the contents will change from 'YES' to 'NO' or vice versa. Click on the boxes until they correctly show what you wish to load. We want to load everything, so you only have to click on the boxes if you have fiddled about with them earlier.

When all of the boxes contain 'YES', click on the OK button. After a few seconds, an image will appear in each window of the Tri-View. At first, the display may seem confusing. This kind of picture is called a wire frame, because the object is displayed as though it were transparent with only the edges visible. To make matters even more confusing, SCULPT 3-D divides each rectangular area with an extra diagonal line. Although this may appear confusing, we will later see how this becomes an advantage when we are building more complicated shapes. Look at the north window. This window will be the one at the bottom left, unless you have rearranged the windows with the DRAG BAR.

The view in the north window should be recognizable as the end view of a simple house with a ridge roof. Note that the wall seems to be braced diagonally in both directions. In fact the north wall (the one furthest away) is braced in one direction while the south wall (the one nearest to you) is braced the other way. In a wire frame view, you cannot distinguish between near and far objects, because far objects are not hidden by those nearby. Now we will look at one way to make sense of these confusing images and at the same time, learn about some of the Tri-View gadgets.

Move the pointer to the west window. Unless it has been moved, it is the one at the bottom right of the screen. Now look at the middle of the left hand border. You will see a gadget with a left pointing arrow. This is called a Move Tri-View Gadget. Click on this gadget with the left mouse button. After the usual screen flashing, try to see what has happened. At first glance, the little house moved to the right (i.e. north). A more useful way of looking at this, is that the Tri-View is moved to the left (i.e. south). That is why the gadget showed a left arrow. It is better to think of the objects in SCULPT 3-D as fixed, and the Tri-View as moving. After a while you will start believing in the reality of the world of SCULPT 3-D.

You should be able to guess what effects the arrow gadgets in the centers of each of the other borders will have. They will move the Tri-View in the indicated direction.

Look at the north window. If you are particularly astute you will have noticed that one of the diagonal braces of the wall has vanished. This is because the brace was part of the north wall, which now lies outside the Tri-View. Click on the gadget in the middle of the right border of the west Tri-View window to move the Tri-View back to its original position. The whole of the house fits inside the Tri-View, so the second brace becomes visible again.

The Tri-View will only render a wire frame image of those lines that are within the chunk of space that the Tri-View represents. When you are dealing with complicated scenes, such as an entire village of little houses, this is a decided advantage. You can move the Tri-

View to the area that you are interested in, and not be bothered by neighboring objects.

Now try using the Sizing Gadget in the bottom right corner of a window to make a window bigger. See how the other windows adjust themselves in order to be consistent. Also notice that although you made the window bigger by stretching out the bottom right corner, as far as the Tri-View is concerned it gets bigger uniformly with respect to its center. If the little house was in the middle of the window before enlarging the window, it will still be in the middle after the enlargement. The image of the house does not get any bigger, there is just more space between the house and the border of the window.

There is another way of changing the size of the Tri-View. Click on the gadget that is near the bottom of the right hand border. This is called the Expand Tri-View Gadget. Somewhat to our surprise, the Tri-View doesn't expand, in fact the little house just gets smaller. This is relativity once again. It is better to think of the chunk of space that the Tri-View represents as getting bigger, even though its image on the screen stays the same. Click on the Expand Tri-View Gadget a few times to make the Tri-View even bigger (or the house even smaller, if you insist). Now can you see why we like to think of the Tri-View's volume increasing even though its image stays the same size. If the image had increased, it would have overflowed off the screen. Expanding the Tri-View is like zooming out with a zoom lens, your view gets wider, so the objects seem smaller.

The Expand Tri-View Gadget increases the volume of the Tri-View equally in all three directions, its width increases by about 40% with each click.

Several SCULPT 3-D commands may be modified by using the keys to the left and right of the space bar. We will refer to these keys as the left and right amiga keys. On some Amigas both of these keys are marked with a large letter 'A', while on later versions of the Amiga, the left key is marked with a Commodore 'C' logo.

If you hold the left Amiga key down while the gadget is clicked, the amount of the expansion is reduced. Similarly, if the right Amiga key is held down when the gadget is pressed, each click of the gadget will have double the usual effect. Several other gadgets, such as the Move Tri-View Gadgets can also be modified by the Amiga keys.

Press the Move Tri-View Gadget a few times until the house vanishes from view. At first, the cursor (the blue cross) moves with the house, but when the motion would have caused the cursor to move off the window, the cursor sticks to the edge. Now expand the Tri-View with the Expand Tri-View Gadget until the house becomes visible. Now point to the middle of the house and press the left mouse button. The cursor will have moved to the middle of the house. Look at the other windows to see if the cursor is really in the middle of the house in all views. If not, repeat the operation in another window. Now click on the gadget that lies second from the left of the bottom border. This is called the Center Tri-View Gadget. It moves the Tri-View so that the cursor is displayed in the middle of the Tri-View.

Now click on the gadget that is second from the right in the bottom border. This is the Contract Tri-View Gadget. It makes the Tri-View smaller, so the image of the house seems larger. Contracting the Tri-View is like zooming in with a zoom lens.

Let us look at one more Tri-View Gadget before moving on to more interesting things. This gadget is called the Reverse Gadget, and it lies just below the top of the right border. It performs a mirror image swap of the particular window. Alternatively, you may think of it as reversing the direction of view. A south view is turned into a north view. Our little house is so boringly symmetrical that you may not even notice the reflection, except that the letters indicating the direction near the left and right borders change places. Notice that the title of a window changes to indicate the change in viewing direction. With a more complicated object, this gadget is more useful.

Making a Picture

If all that SCULPT 3-D could do was to manipulate wire frame renderings, it would be no more than a three dimensional computer aided design package. SCULPT 3-D has extensive image generating capabilities.

SCULPT 3-D makes use of a special object called an observer. The observer can be placed at any location in a scene, and can be instructed to look in a particular direction. In addition, the observer can employ one of three imaging techniques. The acts of the observer are akin to photography, and to follow this analogy the observer can be equipped with different camera and lens combinations.

Let us look at how the observer operates by providing instructions to make a picture of the little house. First we must pick a location from which to view the house. Photographers know that to take a picture of an object with a regular lens, they must position themselves sufficiently far back in order that the image of the object fits within the film size. Use the Expand Tri-View Gadget until the house appears to be about one eighth of the size of the window. Going to the downward looking view, position the cursor at a reasonable distance from the house. Check in one of the other windows to see that the cursor is at some sensible distance above ground level, about as high as the top of the wall will do fine. Move the cursor, if necessary. Then hold down the right mouse button to bring up the menus. Go to the OBSERVER menu and pass down to LOCATION. Release the button.

If you look at the Tri-View closely you will see that a tiny circle has been drawn at the cursor location. That is the observer! It will be easier to see if you move he cursor away. The observer will stay fixed until you next perform an OBSERVER LOCATION command from the menus, or you load another scene from disk.

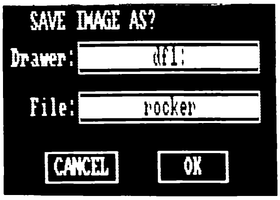
The next thing to consider is in what direction the observer's camera is pointing. Although the observer is not equipped with feet, you will be disappointed with the picture if the camera is pointing downwards. Rather than have you specify camera bearings in degrees, SCULPT 3-D lets you specify a target position. The observer then points the camera at the target so that the target lies in the center of the image. A good target would be the center of the house. Move the cursor there, checking to see that the position is correct in two windows of the Tri-View. Hold down the right mouse button and select TARGET from the OBSERVER menu. Although you will probably not be able to see it for all the clutter of the house, a small x will be drawn at the target location.

Now you can instruct the observer to start taking a picture. Go to the OBSERVER menu and select START. A tiny picture will appear near the bottom of the screen, and after a few seconds will start 'developing'. If you have not accidentally changed any of the observer's attributes, then the picture size will be TINY and the image type will be SNAPSHOT.

If you wish to move the image behind the Tri-View screen, it can be done as follows. Point to the picture and first press the left mouse button. Release it and press the right mouse button. The picture should vanish. This is the same as using a back gadget on a screen that is equipped with one.

The picture can be recalled by going to the OBSERVER menu and selecting SHOW. Let us try a different image of the same scene. Go back to the OBSERVER menu and select MODE PAINTING. Because this is the most rapid method for generating a picture, go to the OBSERVER menu again and select IMAGE SIZE FULL. Finally select OBSERVER START.

Saving An Image



Drawer: df1:

File: rocker

The Save Image Requester

The image that you have just constructed can easily be saved to disk. Hold down the right mouse button and go to the PROJECT menu, follow down to SAVE and then across to IMAGE. Then release the button. A requester will appear on the screen, asking for the name that is to be used when the image is saved on the disk. If you want the data to go to a particular drawer or disk drive, click on the drawer box and type in the name. You must specify a name for the file that you are creating. Click on the file box and type in the name. Filenames may be up to twenty characters in length. The suffix ".image" is added automatically. When you are satisfied with the name that is displayed, click on the OK button. If there happened to already be a file of that name, you would be warned. If you insist upon using the name, then the previous contents of the file will be overwritten by the new image. Large or jumbo images are saved as picture files, smaller images are saved as brushes. Large HAM images can require up to 96K of disk space.

Leaving SCULPT 3-D

If you wish to perform other tasks while SCULPT 3-D is still running, you can push its screen to the back with the Back Gadget at the top right of the screen. You are then free to use the Amiga's multitasking capability, as long as your machine has enough memory.

To exit SCULPT 3-D, execute the menu command PROJECT QUIT. Because you may have some valuable data, scenes or images, that you have neglected to save to the disk, SCULPT 3-D will ask for confirmation before actually stopping execution.

CHAPTER 2

In the last chapter you were briefly introduced to the observer, a feature of SCULPT 3-D that controls how images are produced. In this chapter we will look at the observer in more detail and describe the different kinds of images that can be produced.

Imaging Modes

The simplest kind of image generation involves displaying each visible portion of the objects, with color and shading determined by the specified light sources. SCULPT 3-D calls such an image, a PAINTING. It includes the effects of perspective and the resulting pictures look reasonably solid and realistic. As we shall see in chapter 3, the objects in the world of SCULPT 3-D are made up from triangular pieces. In the PAINTING mode, the image of each piece is 'painted' with the same color. This is not strictly accurate, because if one end of a triangle were closer to the light than the other, it should appear brighter. As the name might suggest, pictures made in this mode can be written to disk and subsequently used as input for one of the paint programs that are available for the Amiga.

The next stage in realism is to use a technique called ray tracing, that computes an intensity and color for each pixel on the screen. A pixel is the smallest area of the screen that can be given a distinct color and brightness. The Amiga usually uses 320 or 640 pixels across the screen and either 200 or 400 pixels in the vertical direction. Shading and color can vary, even across flat surfaces as the distance from the light sources changes. SCULPT 3-D calls the simplest kind of ray traced imaging a SNAPSHOT.

The most realistic images also employ ray tracing, but include the effects of shadows that one object can cast on another. SCULPT 3-D calls this mode of image generation a PHOTO.

The time taken to generate an image depends upon the complexity of the scene, the size of the image and the method used for imaging. The time can vary from a few seconds to many hours.

With both SNAPSHOT and PHOTO modes, it is a good idea to try things out with a TINY or SMALL image size.

You can specify which imaging mode is to be used with the OBSERVER MODE menu command (from now on in this book, we will assume that you have mastered the operation of the menu). The sublist beside MODE shows the three choices, and the currently selected choice is shown with a checkmark. If the current choice is not wanted, move across and change the selection.

The OBSERVER MODE command also lets you choose the screen resolution in both the vertical and horizontal directions. LO-RES and HI-RES refer to low resolution and high resolution in the horizontal direction. NO-INTERLACE and INTERLACE refer to low resolution and high resolution in the vertical direction.

If your imaging method employs Hold and Modify (HAM) graphics in order to use 4096 colors, the image that is displayed will be in LO-RES. HAM is used by the PHOTO and SNAPSHOT modes. If you use HI-RES in the PAINTING mode, then you will be restricted to 16 colors, instead of the 32 that are available in LO-RES.

Images produced with INTERLACE sometimes display an unpleasant flickering. A long persistence monitor reduces this effect.

Moving the Observer

In the last chapter, we explained how to move the observer, but we will repeat it again. First you must select a position in the Tri-View with the cursor. You may need to make the Tri-View bigger, in order that the observer is far enough back to get a reasonable view.

When the cursor is at the right place, go into the menu and select OBSERVER LOCATION. When you execute this command, a small circle will appear to mark the observer's location.

Aiming the Observer

The observer must be instructed which way to look. Although you may know what is the most interesting object in the world of SCULPT 3-D, the observer doesn't. As we explained in chapter 1, the observer always points towards a special spot called the target. This is specified in a similar manner to the way that we picked the observer's location. We move the cursor to the target position and select OBSERVER TARGET from the menu. A small x will mark the spot. The target is usually placed near the most interesting part of the scene, so that it appears in the center of the image.

Camera Lenses

We will frequently be drawing an analogy between the observer and a photographer wielding a camera. If the camera is equipped with a zoom lens, it can zoom in for a telephoto shot where a small angle of view fills the whole picture. Alternatively the camera can zoom back so that the field of view is wide. In a similar way, the observer can be supplied with a lens of your choosing. Use the OBSERVER LENS menu command to examine and change the current selection.

The observer has three standard lenses that should suffice for most scenes. Alternatively you may select the OBSERVER LENS SPECIAL option. When you select this, a requester will prompt you to enter the focal length of a lens of your own design. The smaller the number that you enter, the wider the angle of view, and the smaller an object will appear. A value of 50 corresponds to a normal lens and 28 for a wide angle lens. If you enter a smaller number still, such as 10, then you will get a fish-eye effect with grossly exaggerated perspective. If you chose a number larger than 50 you will enter the realm of the telephoto lens, with distant objects appearing large and with a reduced sense of perspective.

Exposure Control

Most modern cameras have an automatic exposure control so that pictures don't come out too dark or too light. SCULPT 3-D simulates this feature, so that you do not have to worry if you add another lamp to a scene. Like the automatic exposure control on a camera, most of the time SCULPT 3-D does a good job of controlling the brightness of the image. Sometimes, perhaps for artistic reasons, you may want to change the exposure. Select OBSERVER EXPOSURE MANUAL and a requester will pop up asking you to override the automatic setting. Enter a number as a percentage of the standard value. If you want your picture to be twice as bright as normal, enter 200. Because the Amiga screen has a very limited range of brightness, the image that you get may look flat and washed out. Similarly you can enter a number less than 100 if you desire a gloomy and somber effect.

Image Size on the Screen

You can select the size of image that SCULPT 3-D creates. Usually you will want the image to occupy the full size of the screen, but there are a few reasons why you may want to make a smaller image. If you are planning to import your picture into one of the Amiga paint programs, then a small picture may be all you need, particularly if you are using the image as a brush. Another advantage of a small image is that you can continue to work with the Tri-View, with the picture displayed at the bottom of the screen. If you point to the screen near the top of the black area to either side of the picture, and hold down the left mouse button, you can drag the image up the screen or push it down so that it almost vanishes. To do this, you have to hit the black area just right, between about four and twelve scan lines from the top.

Another reason for generating small images is to reduce the time that it takes to create them. Unless you are using the PAINTING mode, the time that it takes to make a picture depends upon the area of the image, so a picture half the size of the screen is made almost four times more quickly than a full size picture. If you are using the SNAPSHOT or PHOTO modes, it is a good idea to try a small image to ensure that everything is correct before starting a full size and much slower picture.

You change the picture size by selecting a choice from the OBSERVER IMAGE SIZE menu selections. The TINY size may run as much as 64 times faster than the FULL size. The JUMBO size is larger than the screen so that no dark border is seen. This is sometimes referred to as overscan. The SMALL image size is one quarter of the width of the screen, the MEDIUM size image is half the width of the screen.

Tilting the Camera

Many photographers have difficulty holding a camera level. You have doubtless seen photos of buildings snapped close to home that resemble the Leaning Tower of Pisa. The observer always holds the camera straight, unless told to do otherwise. You can use the OBSERVER TILT feature of the menus to specify an angle of tilt. You can use a value of 90 to create a vertical format image, or a value of 180 to make the image come out upside down. Other values specify a camera rotation in a counter-clockwise direction. If you enter a negative number, it represents an angle of rotation in a clockwise direction.

Starting the Image Making Process

Now you are ready to start the picture making process, with the OBSERVER START command from the menu. The start command will have no effect if SCULPT 3-D still has not finished the previous image. The cursor will be replaced with the grinding gears cursor. This indicates that SCULPT 3-D is involved in calculating your image. In Paint Mode once the calculations are finished your image will be displayed. In Snapshot and Photo Modes the production of your image will take some additional time.

Hiding and Restoring the Image

Once a picture has been created, or in the case of PHOTOs and SNAPSHOTs even while the image is being produced, it can be removed from the screen in the way that was described in chapter 1. Place the pointer on the picture itself and click the left mouse button, the image of the pointer will vanish. Without moving the mouse, click the right mouse button and the picture will disappear, leaving an unobstructed Tri-View. Before doing anything else, move the pointer inside one of the Tri-View windows and click the left mouse button. Because the menu system is 'connected' to the Tri-View, failure to perform this last step will disable the menus until you click on the window.

The image can be restored to view with the menu command OBSERVER SHOW.

Aborting the Image Making Process

When the observer is instructed to start making a picture in the PHOTO or SNAPSHOT modes, there is a short period when the full capacity of the Amiga is required. During this time, the pointer will turn into the grinding gearwheel image. As soon as the regular pointer returns, you are free to continue working with the Tri-View, even though the image is being generated. Changes that you make to the object, will not affect the image.

If you decide that you do not want the image, you can use the OBSERVER ABORT menu command to stop the processing. After an image has been aborted, the OBSERVER SHOW command will have no effect, the image, and the memory that it used, really has gone.

The Jaggies

Computer images are built up from discrete pixels. Even with 640 by 400 pixels, the image is still ten times more coarse than a 35mm slide. The regular layout of the pixels makes them evident to the eye, particularly when there is a sharp transition from one color to another along a line that is nearly horizontal or nearly vertical.

A technique called anti-aliasing can be used to reduce the effects of 'the jaggies'. Because anti-aliasing makes images look slightly blurred, and takes additional computing time, you can control the anti-aliasing method with the command OBSERVER ANTI-ALIASING. Three modes are available: NONE, GOOD and BEST. You should use NONE while you are composing the scene and then try GOOD or BEST to see which produces the most pleasing image.

Controlling the Number of Colors

Colors are generated by mixing red, green and blue light. The amount of each color is specified by a number. On the Amiga hardware, this number can range from zero to fifteen. Because each number can be chosen independently, the Amiga can display 4096 different colors. In the PAINTING mode, the Amiga restricts the number of colors that can be displayed to 16 for high resolution displays and 32 for low resolution displays. SCULPT 3-D attempts to chose the 16 or 32 colors that best represent the scene from the set of 4096 possible colors.

Some Amiga programs further restrict the number of colors that can be used. If you plan to use an image produced by SCULPT 3-D in such a program, you must issue a command to restrict the number of colors that are used. The command OBSERVER MODE BIT PLANES does this for you. A requester pops up asking you how many bit planes you require. A single bit plane lets you use two colors. Each additional bit plane doubles the number of colors. Choose the number of bit planes as follows:

Bit planes	Colors
1	2
2	4
3	8
4	16
5	32 (LO-RES only)

If you specify zero bit planes, then SCULPT 3-D will use the maximum possible number.

Although the Amiga display hardware can utilize 4096 colors, this is not enough if you want the highest possible quality image. Each of the primary colors can only take on one of 16 values, so colors jump by about 8% from one level to the next. The human eye can easily detect this transition. SCULPT 3-D uses a dithering technique to blur out the transitions but this results in a grainy appearance. SCULPT 3-D can generate the data for images with more than 4096 colors, but the Amiga cannot display them. If you specify 24 bit planes, with the BIT PLANES command, then SCULPT 3-D will carry out the calculations for 16 million colors. You will be asked if you wish to save the results in a special file, called an RGB file.

RGB files can be used with other computers and also with the Amiga if you have a special piece of hardware called a Frame Buffer. With a frame buffer, the image quality produced by SCULPT 3-D rivals that of professional animation stations costing many times that of an Amiga based system. Additional software may be needed to use the RGB files with particular brands of frame buffer.

CHAPTER 3

In this chapter we will describe the way that SCULPT 3-D represents solid objects, and how you can design any shape with your mouse.

Low Level Object Building

Objects in SCULPT 3-D are built up from small triangles. It is the edges of the triangles that you see as the wire frame image in the Tri-View. In this chapter we will describe the lowest level of object building. We will be dealing with the triangles on an individual basis. To build a complicated object in this manner would be extremely tedious. In chapter 4 we will introduce some power tools that enable you to conjure up complicated shapes with hundreds of triangles with only a few strokes and clicks of the mouse.

Once you know how the low level construction is performed, you will be in a better position to use the power tools, and the operations that we will be describing in this chapter will be useful when we make subtle modifications to the objects that are hewn by more powerful techniques.

Vertices

The simplest entity that SCULPT 3-D can handle is called a vertex (the plural of vertex is vertices). A vertex is just a fancy name for a point at the corner of a triangle. We had better not call it a point, because that word is already overused, we might otherwise have to say 'point the pointer at the point!'

If you remember how we located the observer within the Tri-View, you will not be surprised at how we create a vertex. First we position the cursor at the exact spot where we would like a vertex. Then, still holding down the left mouse button, click the right mouse button. Instead of bringing up the menu, clicking the right button with the left button down will create a new vertex. It is portrayed in the Tri-View by a bright yellow dot. Try it. But at this stage do not make more than three of them, we will see why in a moment. Create the three vertices in a triangular pattern about half the size of the Tri-View.

Edges

The next step in low level construction is to build edges. Edges always end at a vertex. In fact, the only purpose for having vertices is to define the position of edges.

If you succeeded in creating three vertices, there is a gadget that you can use to join the vertices. It is located near the bottom of the left hand border of each window. Its icon is a triangle. Click on it and see that dark lines are drawn between the vertices. This is how the Tri-View portrays edges.

If, for some reason, edges were not created, and the screen simply flashed at you when you clicked on the Edge Building Gadget, it was probably because, in a rush of enthusiasm, you had created more than three vertices. You can clear away the vertices by using the EDIT ERASE ALL menu command. Create three new vertices and try to construct the edges again.

Why is the Edge Building Gadget so pernickety? If you had only created two vertices, it would have happily joined them with a single edge. If you had a dozen vertices, the Edge Builder would have had to make 66 edges to join all combinations of vertices. This might make a credible image of a birds nest, but it would have little other use. This is why the Edge Builder will only work with either two or three vertices, building one or three edges, respectively.

Faces

The next, and fortunately last, element that we must consider is called a face. In SCULPT 3-D all faces are triangular. There is no need to provide a gadget to create faces, for SCULPT 3-D has a rule: whenever three vertices are joined by three edges, a face is automatically created. So, unbeknownst to yourself, you have already built a face. It is hardly surprising that you did not notice, because faces are not depicted in the Tri-View. They don't have to be shown, because whenever edges make a triangle, a face will be there.

Although faces are not rendered in the Tri-View, they are the only parts of an object that are seen by the observer when making an image. Vertices and edges are never seen in the final picture.

To prove this, go to another window. Your triangle will probably look like a straight line, because it is being viewed edge on. Move the cursor away at right angles from the line, expanding the Tri-View, if necessary, and locate the observer at this point using the OBSERVER LOCATION menu command. Next, move the cursor back to the triangle, checking in two windows to be sure of its position in three dimensions. Then use the OBSERVER TARGET menu command to point the observer at the triangle. Start the image making process with OBSERVER START.

The picture that will be created will hardly be a work of art. Indeed, even if you have done everything exactly right, you will only see the dark silhouette of a triangle. This is because we forgot to turn on the lamp. Move the cursor back to the vicinity of the observer and a small distance to one side. To create a lamp, execute the EDIT LAMPS CREATE menu command. This time, if you make a picture with the OBSERVER START command, the triangle should be flooded with light. If the lamp was sufficiently to one side, and you are in SNAPSHOT or PHOTO mode, you may even see a hint of shading across the otherwise bland triangle.

This really does seem like a lot of bother just to draw a triangle. Fortunately, we will soon be using tools that will mass produce faces so that you can sculpt shapes of any kind.

Selecting Vertices

SCULPT 3-D uses a variety of methods for choosing vertices with which to work. It distinguishes between selected and unselected vertices. If a vertex is selected, it is portrayed as a bright yellow dot. The vertices that you created by holding down the left mouse button and clicking the right button were shown in yellow, so they were selected vertices. If you remember the little house from Chapter 1, you might recall that the vertices were a dull purple. These were unselected vertices.

To change the state of selection of a vertex, you must point at the vertex, either with the pointer or the cursor, and double click the left mouse button. The color of the vertex will change from yellow to purple or vice versa. Selected vertices are yellow and unselected vertices are purple. Try changing the selection state of the vertices that you have created.

In order to change a vertex, the pointer must be within a few pixels of the correct spot. If SCULPT 3-D cannot find a vertex in the immediate vicinity, no vertex will be changed, but the screen will flash briefly to warn you that you missed.

We are now in a position to understand the peculiarities of the Edge Building Gadget. It will construct edges between the selected vertices, provided that either two or three vertices are selected. If some other number of vertices is selected, the screen will flash a warning.

You have enough information to create a triangular net of vertices and edges. Turn off the selection of all but two vertices and use the Edge Builder to create a new edge. Remember that each time you complete a triangle with three edges, a face is constructed, and it is these faces that are visible when you use the observer to generate an image.

If you move from window to window, your vertices will not all lie in one plane and you can construct solid shapes. Try to construct a pyramid, and then see what it looks like to the observer. Remember that you have to have at least one lamp suitably placed or your constructions will just look like a dark hulk.

To create a lamp, position the cursor at a suitable spot, preferably behind, above and to the side of the observer, and execute the command EDIT LAMPS CREATE.

If you succeeded in fabricating a pyramid, try to build a cube. In order that visible faces are created, you will have to triangulate each square side with an extra diagonal edge. If you wanted to make something that looks like an open box, you could leave out the diagonal on the top side. Try doing this, and look at the resulting image.

An alternative way of selecting vertices is with the Select Gadget. It can be found near the top of the left border of a Tri-View window. Its icon is three dots. This gadget only changes the selection state of vertices that are inside the Tri-View. We will make use of this property in a moment.

The action of the gadget is as follows. If one or more vertices in the Tri-View are selected, then the gadget deselects the vertices. If no vertices in the Tri-View are selected, then the gadget causes all of them to be selected. You can use the gadget to toggle all the visible vertices between selected and deselected. The Select Gadget never changes vertices that lie outside the Tri-View.

A useful trick when you wish to select only some vertices of an object, is to move the Tri-View, or expand or contract it until only those vertices that you wish to change remain inside. The Select Gadget will then change these vertices.

There are yet more ways to change the selection state. The menu command EDIT SELECT ALL and EDIT DESELECT ALL can be used to select or deselect every vertex, not just those in the Tri-View.

The companion commands, EDIT SELECT CONNECTED and EDIT DESELECT CONNECTED operate on all vertices that are connected to the indicated vertex. The term 'indicated vertex' means a vertex within a few pixels of the cursor. Any other vertex that is linked by an edge, either directly or indirectly to the indicated vertex is considered to be connected to it.

For example, if you were to reload the little house, you would find that the roof was connected together, but was not connected to the walls. All four walls are connected together. This makes it easy to select the roof, without changing the walls. There are many operations that SCULPT 3-D can perform that only apply to selected vertices. Later in this chapter we will see how to literally raise the roof.

Erasing Objects

SCULPT 3-D is an editor for solid objects. So far, we have seen how to enter vertices and edges, and due to the rules, we make faces. What happens if a mistake is made?

The EDIT ERASE portion of the menu provides a number of options. The first selection, EDIT ERASE SELECTED VERTICES does what you might expect. Only selected, i.e. yellow, vertices are removed. Since an edge is defined in terms of vertices, any edge that is connected to a selected vertex is also deleted. Because a face requires three edges, the removal of edges may result in faces being erased also. The EDIT ERASE SELECTED VERTICES command works on all selected vertices, so you should be careful that you do not have a selected vertex outside the Tri-View, otherwise it will vanish also.

The next erase command, EDIT ERASE SELECTED EDGES, is very similar. A selected edge is one that has selected vertices at both ends. For example, if you had made a cube with diagonal braces on all six sides, you could open up one side by removing a brace. Simply select the vertices at either end of the edge to be removed. The EDIT ERASE SELECTED EDGES command will remove the edge.

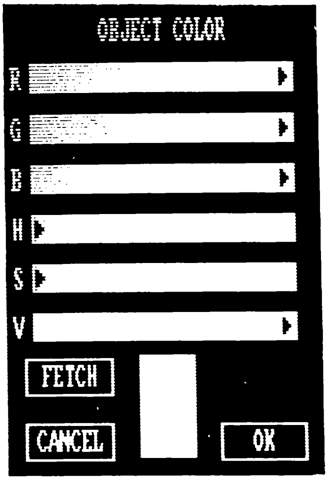
The next two commands can be used to remove lamps from the scene. EDIT ERASE INDICATED LAMP will erase a single lamp. You select which lamp by moving the cursor to the lamp to be removed. You must be within a pixel or two for the command to be effective. The command EDIT ERASE ALL LAMPS is much less subtle, it removes all your lamps.

If you only need to remove a single vertex, you could ensure that it is the only selected vertex and you use the command EDIT ERASE SELECTED VERTICES. It is usually easier to move the cursor to the vertex and use the command EDIT ERASE INDICATED VERTEX. The corresponding command EDIT ERASE INDICATED EDGE can be used to erase a single edge.

The last erase command is EDIT ERASE ALL. It removes all vertices, edges and faces as well as all lamps. Because this could be catastrophic, for example if you have just built an elaborate scene and neglected to save it to the disk, SCULPT 3-D will ask if you really want everything erased in order to give you a chance to retract the command.

Color and texture

By now, you must have become aware that all the objects that you have made have been white, and that the effects of shading have only created different shades of gray. Every time SCULPT 3-D creates a face, the face is given the current color. If you want to see what the current color is, execute the menu command EDIT COLOR.



The Color Requester

An object color requester will pop up. The current color is displayed in the box at the bottom of the requester. The set of six sliders can be used to control the color. The first three sliders control the amount of red, green and blue. To operate a slider, point at the triangular knob and hold down the left mouse button. If you move the mouse from side to side, the knob will move to follow it, and the current color will change. With a little practice, you can mix the red, green and blue to achieve almost any hue.

If you find it difficult to get just the right shade with the RGB sliders, try using the lower three that are labelled H, S and V for hue, saturation and value. It is a good idea to move the S slider and the V slider all the way to the right. If you then move the H slider very slowly it will change the color smoothly from red to green to blue and back to red again, with many shades in between.

Having established the correct hue, you can move the saturation or S slider to the left in order to dilute the color with white. Finally you can use the V slider to make the color darker or brighter.

Once you have set the correct color, any faces that are generated will have that color. What if you forgot to set the color? The color of a face can be changed at any time. First you must choose the color, just as you did before. Then select the vertices that surround each triangular face, either by double clicking, or using one of the other methods that we described earlier in this chapter. Finally use the EDIT MODIFY COLOR OF SELECTED FACES menu command. The colors of all the selected faces will be changed to the current color.

In addition to color, each face has a texture, it can either be dull, shiny or mirror. The current value is set with the commands EDIT TEXTURE DULL, EDIT TEXTURE SHINY, EDIT TEXTURE MIRROR, or EDIT TEXTURE LUMINOUS. A dull texture scatters light uniformly in all directions. A shiny finish throws most of the light uniformly, but reflects some in a particular direction, which can cause an object to glint, or have highlights. A mirrored surface reflects all the light in a particular direction, so that reflected images may be seen in a mirrored surface. A luminous surface reflects no light at all but emits light independently of its surroundings. The color on the screen will be the color set by the EDIT COLOR command. If you also set a color other than white, the reflection will be colored, also. The texture of selected faces can be changed to the current texture by the command EDIT MODIFY TEXTURE.

Remember that changing the current color does not change the color of any existing color, it only effects the color of new faces that are created. If you decide that you need to change the color of one or more faces, you must perform the following three steps. First select the face or faces by selecting all the vertices that are the corners of the faces. Then use the EDIT COLOR command to select a new current color. Finally issue the command EDIT MODIFY COLOR OF SELECTED FACES. Many people forget this last step and are then puzzled that the color of an object has not changed.

If you need to create an object with the same color as an existing object, there is a mechanism for setting the current color to an earlier value. Select a face that has the desired color and execute the EDIT COLOR command. Press the FETCH button, and the sliders will move to correspond to the color of the selected face. You can accept this value as the new current value by clicking on OK. If more than one face is selected, and they have different colors, the FETCH operation will retrieve the average color of the selected faces.

The Grabber

Up to this point, we have assumed that the objects that you have built are perfect, that you have never made a mistake or changed your mind. Except for erasing all or part of an object, there has been no way for you to make changes.

The Grabber Gadget is a low level tool for changing the position of one or more vertices. If you change the position of a vertex, any edges or faces that are attached to the vertex will be stretched to follow it. The Grabber Gadget resides in the lower left corner of each Tri-View window. Its icon is supposed to look like the crane operated gripping tool that is used in automobile wrecking yards. If you click on the Grabber icon, you will see its jaws close. It is then active. It can be turned off by clicking on it a second time, or by pressing the right hand menu button. When the Grabber is active, the cursor changes its form as a reminder that the Grabber is active.

To try the Grabber, first make sure that it has been turned off. Clear the Tri-View with an EDIT ERASE ALL command. Then make three vertices, and join them with the Edge Builder Gadget. Select two of the vertices and turn on the Grabber. All the time that the Grabber is on, the selected vertices will move whenever the cursor is moved. The edges will stretch to follow. It is a good idea to position the cursor on one of the selected vertices before you turn the grabber on. Then you can point to the destination for that vertex and when you click the left mouse button, the vertex will jump to its new place, and the other selected vertices will move in formation.

To try a more elaborate example, EDIT ERASE ALL to clear the Tri-View. Then PROJECT LOAD SCENE and request 'littlehouse'. When it has loaded, select one of the vertices at the top of the roof. Then execute the EDIT SELECT CONNECTED command and the whole roof structure will be selected. Turn on the Grabber and point to the north window. Then move the cursor up and raise the roof!

CHAPTER 4

In this chapter we will present the 'power tools' that enable you to easily build elaborately shaped objects.

Smoothing

In this section we will describe an attribute of faces that is only useful for the complicated objects that we will be building in this chapter. You may recall that faces have two other attributes: color and texture. The third attribute is smoothness. When a face is created, it inherits the current color, texture and smoothness.

The current smoothness value is specified with the commands EDIT SMOOTHING ON and EDIT SMOOTHING OFF. If a face is smoothed, then it will reflect light as though the surface was smoothly curved to blend in with its neighbors. This is only useful when you make images with the SNAPSHOT or PHOTO modes. The particular method that is used to calculate the curvature is called Phong smoothing.

If you wish to change the smoothing parameter for a face that already exists, first change the current smoothing value, then select the face and finally execute the menu command EDIT MODIFY SMOOTHING FOR SELECTED FACES.

Spheres

Because SCULPT 3-D builds everything from triangular faces, it cannot represent a sphere exactly. A geodesic dome represents a good approximation to a sphere, yet it is also built from triangular elements. Using the tools from the last chapter, it would be possible, although extremely tedious, to construct a dome.

There is a much easier way. Execute the menu command EDIT ADD SPHERE. A requester will pop up and ask you how many times you wish to subdivide the sphere. If you ask for no subdivision, by simply pressing the OK button, SCULPT 3-D will construct a geometrical figure with 20 faces called an icosahedron. Set up a lamp and make a picture of this object with the SNAPSHOT mode. It is a pretty poor approximation to a sphere, but if you modify each face with the smoothing option, then a more credible image of a sphere will result.

To apply the smoothing attribute to an object, you must first select every vertex. Since the icosahedron lies entirely within the Tri-View, you can use the Select Gadget to select each vertex. Then execute the EDIT SMOOTHING ON menu command, so that all new faces that are generated will have this property. To change the existing selected faces, use EDIT MODIFY SMOOTHING FOR SELECTED FACES. Now make a new image of the object, and although the outline still seems angular, the shading will make the object look quite smooth. If the final size of the object in the picture is fairly small, this may be adequate to represent a sphere.

To make a better approximation to a sphere, we may subdivide each face. The EDIT DO SUBDIVIDE menu command will divide each selected edge in two, creating a new vertex at the midpoint of each edge. Then it links these midpoints with new edges. Each selected face will be divided into four. Try this operation on the icosahedron, being sure that each vertex is selected. The resulting object will have 80 faces, but will still look like an icosahedron because the new vertices lie on the edges of the old icosahedron. What we need to do is to inflate the object by pushing the new vertices outwards a small amount.

There is a command EDIT O BE SPHERE that does just what we want. Most of the commands that we will be using, operate only on the selected vertices. This would not make much sense for BE SPHERE. It works on all vertices that are connected to the indicated selected vertex. This means that BE SPHERE works on connected objects, which is only right and proper. The BE SPHERE command figures out where the center of the object is, and then moves all the vertices so that they are the same distance from the center. Move the cursor to a vertex of the subdivided icosahedron. Then execute EDIT DO BE SPHERE. Even in the Tri-View, the object looks quite spherical. Make a picture and see.

You could repeat this sequence of SUBDIVIDE and BE SPHERE to build better and better approximations to a sphere. Because each stage quadruples the number of faces, it will not be long before

SCULPT 3-D starts to run very slowly because of the sheer complexity of the object. If you persist, SCULPT 3-D will run out of memory. A much easier way of subdividing a sphere, is to specify the number of subdivisions when the requester for EDIT ADD SPHERE pops up. Instead of just pressing the OK button, click on the box containing the number. Erase the number with the backspace and DEL keys. Then type in a new value, either 1 or 2, unless you want to risk exceeding the capacity of the Amiga.

Other Curved Shapes

Besides spheres, there is an add command to create a HEMISPHERE, a CONE, a CYLINDER, a TUBE, a DISK and a CIRCLE. Each command prompts you for a number to control the degree of subdivision.

The EDIT ADD HEMISPHERE command constructs a hemisphere with a flat filled in base. If you just want a hemispherical shell, you can erase the vertex at the center and the base will vanish. The EDIT ADD CONE command constructs a cone with a flat base. The base can be removed in a similar way.

A tube differs from a cylinder in that the ends are not closed. If you want a tube with one end closed, create a cylinder and delete the vertex in the middle of the end that you want to be open.

A disk is a flat circular object that does not enclose a volume. Nevertheless it can prove useful in the construction of a variety of more complicated objects.

A circle consists of a linked series of edges, with no faces at all, so it is not visible in an image. Like the disk, it is useful for making other shapes.

Cubes

Angular shapes like a cube can be represented exactly by SCULPT 3-D, although if the object has rectangular faces, they will have to be subdivided by adding an extra diagonal edge. SCULPT 3-D can produce a cube with the EDIT ADD CUBE command. In the next chapter we will introduce a mechanism for changing the shape and size of objects. Although it is less convenient, we can use the Grabber Gadget to do the same job.

Suppose we wanted to build a block that is twice as large in one direction as it is in other directions. Clear the Tri-View with an EDIT ERASE ALL. Turn off smoothing with EDIT SMOOTHING OFF. Then make the cube with EDIT ADD CUBE.

Whenever SCULPT 3-D generates an object with the EDIT ADD group of commands, the new object will be sized to almost fit the Tri-View. If we want to double the size of our block, we had better increase the size of the Tri-View to make room. Click on the Tri-View Expand Gadget twice. Now we want to select the four vertices that make up one end of the cube. One way is to move the Tri-View so that part of the cube sticks outside. Then use the Select Gadget to turn on the four vertices that remain. Turn on the Grabber and choosing the correct window, pull out the end of the cube until it reaches the desired length.

If you do not have a steady hand, you may find that you have pulled the cube out to a lozenge shape. Remember that in case you ever need to build a lozenge.

Prisms

The command EDIT ADD PRISM is exactly analogous to the command for cubes. The prism will be oriented conveniently for use as the roof of a building. If you need to change the pitch of the roof, select the two upper vertices. It is easiest to double click on them, this time. If you turn on the Grabber, you can pull up the ridge, or offset it to one side for an asymmetrical style. Similarly, if you want anything other than a square plan, turn off the Grabber and select only one end of the roof before pulling or pushing with the Grabber.

Drawing Curves

Many objects have symmetry about an axis. Examples include a cone, a doughnut, a cylinder, a pawn in a chess set, a candlestick and an hourglass. All of these objects can be described in terms of an axis and a curve. The curve is swept around the axis to produce the object. We will describe this operation shortly, but first let us look at how to describe curves with SCULPT 3-D.

A curved line is approximated by a series of vertices joined by edges. Although we could make them using the methods of chapter 3, there is an easier way. Execute the command TOOLS CURVE.

Notice that the form of the cursor has changed. You have picked up the curve tool. It operates like the regular cursor, you can hold down the left mouse button to move the tool. If you press the right button, while the left button is held down, then a new vertex is created. Unlike the regular cursor, subsequent vertices will be joined to their predecessor, so you can easily create a linked set of vertices.

You may release the curve tool at any time by clicking the right mouse button. If you position the tool close to an existing vertex, this will be chosen when you try to create a new vertex. In this way you can create closed loops. When a loop is closed, the curve tool is dropped, i.e. the regular cursor returns.

A closed loop would be just what you needed if you had to create a flat object with an arbitrary shape. If you tried to make an image of such an object, it would be invisible, because although you would have created vertices and edges, there would be no triangular faces. You could construct additional edges, to triangulate the interior of the loop, but SCULPT 3-D provides just such a tool. Construct a closed loop in some interesting shape and ensure that all the vertices are selected. Then execute the EDIT DO FILL command. The interior of the loop will be triangulated. This command will only work if all the selected vertices lie in a single plane, and all the selected vertices are members of one or more closed loops.

Erase the object and construct a closed loop. Then choose the curve tool again and make another loop entirely inside the first. If you use the EDIT DO FILL command, this time the second loop will serve to define a hole in the triangulated object.

Spinning Objects

The spin device is the mechanism that SCULPT 3-D provides for generating solid objects by sweeping a curve or a loop around an axis. To make it work, you must first prepare a set of selected vertices linked by edges. Then you must specify an axis of symmetry. The axis is always horizontal on the screen and passes through the cursor location from left to right in the active Tri-View window.

When you are satisfied with the curve, and the location of the axis, execute the EDIT DO SPIN menu command to generate a new shape. This command will pop up a requester asking how many steps are to be taken as the curve is swept around the axis. You must use at least three. The more you choose, the smoother will be the resulting object, but the more resources that will be consumed.

Experiment with the spin tool to see how many different shapes you can build. Make a sphere. How does it differ from a sphere made with the EDIT ADD SPHERE command? Use the EDIT ADD CIRCLE command to make a circle. Select the vertices and move the cursor below the circle. If you now use the spin tool, you will create a torus with a circular cross section.

You will probably wish to have SMOOTHING turned on with the EDIT SMOOTHING ON command. As we explained earlier, this will minimize the triangular faceted appearance of the solid that is produced, although the object's outline will still be made from straight line segments.

Extruding Shapes

The extrude tool can be used like a cookie cutter to make solid shapes from two dimensional profiles. Once again the CURVE tool is used to draw one or more closed loops. When you are satisfied that you have created the cross section of the shape that you desire to extrude, execute the TOOLS EXTRUDE command. There will be a pause while SCULPT 3-D performs a fill operation on the curves. When the pointer returns on the screen, notice that the Grabber tool has been turned on. If you now select an alternate Tri-View window and move the cursor, you will see the original loops split into two. An unselected, purple, set remains fixed, while the yellow, selected, set can be dragged with the cursor. Edges joining the two ends of the object will have been created by the extrude tool.

When the extruded shape has the right form, press the right mouse button or click the Grabber icon to turn it off. If you had traced out the outline of a building in plan form, you could use the extrude tool to raise the walls with one stroke of the mouse. It can also be used to build three dimensional alphabetic characters and many other objects.

The Unslice Operation

If you want to construct shapes that are largely lacking in symmetry, and you do not wish to build them one vertex at a time, then the EDIT DO UNSLICE command can be used. In order to use this command, you must visualize the shape in terms of a series of parallel cross sections or slices. Each slice must contain only one closed loop.

A slice may easily be constructed using the CURVE tool. After the loop is drawn, go to another window and move the cursor to the location of the next slice. Then go back to the first window to draw the next loop. Before invoking the unslice operation it is a good idea to save the loops with a PROJECT SAVE SCENE or PROJECT SAVE OBJECT command. It is much easier to edit the slices to make corrections, than it is to work with the completed object.

Make sure that all the vertices that make up the loops are selected, and that no others are selected. Execute the command EDIT DO UNSLICE, and the loops will be linked into a single surface. If the outermost loops are triangles, then the surface will be closed. Using the unslice command successfully requires careful preparation. All the selected vertices must be part of a series of loops. The planes of each loop must be parallel.

There is no unique way to link the loops, so the unslice command uses a heuristic approach to tackle the problem. Do not be surprised if the solid that it generates differs from the one you anticipated. Adding additional slices, so that one slice is not too different from its neighbors will serve to define the shape with more precision.

For the utmost control in building irregular solid objects, the extrude tool may be used several times, with some low level manipulation of the vertices between each use of the tool.

Building Mirror Images

Some objects, like a left glove, have an associated object (a right glove in this case) that only differs only in that it is a mirror image of the first. If you had painstakingly built a model of a left glove, the REFLECT operation enables you to build its mirror image automatically.

To use this facility, you must select all the vertices of the object or objects that you want to reflect. Choose one window and position the cursor to the left of all the selected vertices. The imaginary plane of reflection will appear to be vertical in the current window, and it will pass through the cursor position. Execute the command EDIT

DO REFLECT, and a mirror image of the selected objects will appear to the left of the cursor.

With one exception the cursor, and hence the plane of reflection, may be placed at any location. If the plane of reflection passes through the selected object, the object and its reflection will partly overlap. They may subsequently be separated with the grabber.

If a vertex lies exactly (or within a pixel or two) in the plane of reflection, the vertex is not duplicated and the object and its reflection will be connected through the vertices that lie in the plane of reflection. This provides an easy way to make objects that have a plane of symmetry.

For example, a human head is approximately symmetrical. If you were to build the left half of a head, you would only have to construct one eye, one ear and half a nose and half a mouth. If you are careful and ensure that all the vertices that lie on the center plane, then they will appear to lie in a straight line in one of the Tri-View windows. If you select this window and position the cursor so that the plane of reflection coincides with the center plane, then the REFLECT operation will construct a complete head from the half-head.

The REFLECT operation can often be paired with the UNSLICE operation. Sometimes the REFLECT will be performed first, and at other times the UNSLICE is performed first. In either case the idea is to create either a half set of loops or a set of half loops. Save these curves, and then construct the full object. If changes are required, return to the curves and make any needed changes before constructing the object anew.

CHAPTER 5

In this chapter we will look at ways that we can rotate, move and change the shape of objects.

Rotating Objects

We may not always want our objects to be lined up with the axes of the Tri-View. If we are building a model of a city, and we use the EDIT ADD CUBE command to produce buildings, we have no easy way to produce a cube that faces to the south east.

The Rotate Gadgets will rotate any selected object. Erase all the objects and make a cube. Position the cursor at the center of the cube and select all eight of the vertices. If you now click on one of the Rotate Gadgets at the top left border of the Tri-View window. You will see the cube rotate 5 degrees for each click. If you hold down the right Amiga key, then the rotation step is increased to 45 degrees. Similarly if the left Amiga key is held down, the rotation step is only one degree.

If you move to another window, you will be able to revolve the cube around a different axis. Next expand the Tri-View to about ten times its original size and position the cursor at some distance from the diminutive cube. Click the Rotate Gadget and you will see the little cube move in a circular orbit around the cursor.

In summary, the Rotate Gadget rotates all the selected vertices around the cursor. Be careful that you do not have any vertices accidentally selected outside the Tri-View, because they will be rotated also. You probably will want to select all the connected vertices of an object otherwise only part of the object will be rotated. The effect may be interesting, but will quickly lead to a tangled set of edges.

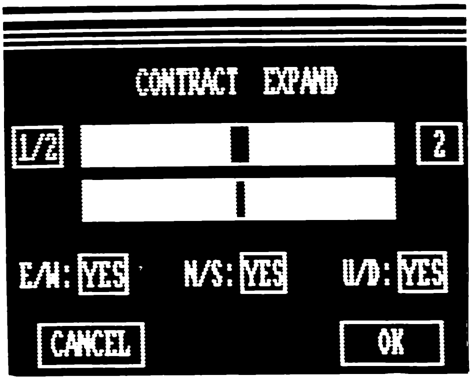
Manipulating Shapes

The Grabber Gadget can be used to move one or more vertices, so it provides a very general way to manipulate an object.

Suppose that you wish to create a long cylinder with spherical ends. First construct a sphere with the EDIT ADD SPHERE command. Use a subdivision value of one or two. Then move the Tri-View so that exactly half of the sphere is sticking out of the Tri-View. Now if you use the Select Gadget, you will find that you have selected all the vertices on one hemisphere. Expand the Tri-View to make room for what will follow. Turn on the Grabber and you will find that you can pull the two halves of the sphere to make the cylinder with rounded ends.

We have already used the same method with a cube to make rectangular blocks.

Expansion and Contraction



E/W: YES N/S: YES U/D: YES

The Expand / Contract Requester

Each of the EDIT ADD sequence of commands creates an object just a little smaller than the size of the Tri-View. This would be inconvenient and unsatisfactory if we wanted an object of a specific size, because we cannot specify the size of the Tri-View exactly, we can only change it in steps. Besides, if we found that we had created an object of the wrong size, our only recourse would be to erase it and try again, or start fiddling around with the Grabber. That would hardly be practical for a pseudo-sphere with 320 faces.

Fortunately there is a command that enables you to change the size of an object with great precision.

First make a subdivided sphere and select all the vertices. Then execute an EDIT DO EXPAND command. An expansion requester will pop up. Unlike other requesters, this one has a drag bar along the top. Move the requester so that you have a good view of each of the Tri-View windows. You will see that the requester has two gadgets to halve and double the size of the selected objects. Try the halving gadget first, otherwise you will probably double the sphere out of sight.

You can use the upper slider to continuously change the size of the object. The lower slider operates just the same way except that it is much less sensitive. You will hardly be able to see the changes it produces. Later in this chapter, we will introduce a measuring gadget in case you need to find out the exact size of the object.

You can use the gadgets near the bottom of the requester to limit the expansion to one or two directions. Click on the boxes and see them toggle between YES and NO. Turn off two of the directions and then try contracting the sphere. You will see it flatten out like a pancake.

The expansion device is much more convenient than the Grabber for making rectangular blocks from cubes. Note that the expansion applies to all selected vertices and that the expansion is away from the centroid, or average position of the selected vertices.

The Magnet Tools

If you need to pull or push several vertices, then the Grabber tool will do that for you. However it moves them all the same amount. Sometimes you may want to move some further than others. This is what the magnet tools do.

Erase all objects and create a few vertices. Ensure that they are selected. Now execute the menu command TOOLS MAGNET ATTRACT and you will see the cursor turn into an icon for a horse-shoe magnet. As usual if you hold down the left mouse button, you can drag the tool around. If, while holding down the left button, you click the right mouse button, then all the selected vertices will move a small distance towards the magnet. If a vertex is far from the magnet the vertex will only move a small distance. Just like a real magnet, the attraction gets weaker at increasing distances. When a vertex gets very close to the magnet, the attraction gets weaker again in order to prevent the vertex from overshooting the magnet. Try it and see how the vertices move.

The strength of the magnet can be varied. If the left Amiga key is held down (as well as the left mouse button), when the right button is clicked, the strength is reduced. If the right Amiga key is held down, the strength is increased. If you select TOOLS MAGNET REPEL, everything works as before, except that the selected vertices move away from the magnet. The magnet tool is released by clicking the right mouse button without holding down the left button.

Erase everything and make three vertices arranged in a large equal sided triangle. Join the vertices with edges. Ensure that the three vertices are selected and execute the EDIT DO SUBDIVIDE command a few times until you have made a triangular grid. Position the cursor at the center of the grid, and then move to another Tri-View window. Move the cursor away from the grid and select the MAGNET ATTRACT tool. Operate the magnet a few times and see what happens. The net of points will deform and a spike will be pulled out towards the magnet.

If you repeat the experiment with a new grid, but use the magnet to repel the vertices, the grid is deformed, but the bump is rounded rather than spiky. By moving the magnet between pulses and by switching from attraction to repulsion, there is hardly any limit to the forms that can be built.

If you operate the magnet in a Tri-View that is large, the strength of the magnet is increased, so that its effect appears to be the same. If the Tri-View is contracted, the magnet gets weaker and it can be used to make very delicate modifications to a small portion of an object.

The Selector Tools

Many of the tools, commands and gadgets only work with selected vertices, edges or faces. There are two tools designed specifically for selecting vertices. If you issue the command TOOLS SELECTOR, the cursor changes into a yellow square. This is the Selector Tool. It represents a cube that you can move around in three dimensions. If you pass the cube over a vertex it will become selected. If this does not seem to happen, it is because you are at the wrong depth. Look in one of the other Tri-View windows to see where the cube is really located. Click the right mouse button to drop the tool.

The complementary tool can be selected with the command TOOLS DESELECTOR. This time the little cube is purple and it deselects everything that it passes through.

Creating More Complex Objects

You now are in a position to build objects of any conceivable shape. Two objects can be combined just by placing them together. It doesn't matter if one intersects with another. SCULPT 3-D will take care of the details and the image that is produced is just what you would expect. Suppose that one object resembled a human head, but lacked a nose. You could construct a nose shaped object, and using the Grabber, position it at the right place with regard to the head. By keeping them as separate objects, you can select either one or both. By selecting the nose, you can use the expand requester to make it bigger or smaller. If both the nose and the head are selected, then the Rotate Gadgets could turn the head from one side to another, and the nose would follow.

If you decide that the nose is in the correct relationship to the head, you could connect the two with a single edge. Remember that an edge, by itself, is invisible in an image. If you then perform an EDIT SELECT CONNECTED on any vertex in the head or the nose, both objects would be completely selected.

Duplicating Objects

Sometimes you will need several copies of the same object. The command EDIT ADD DUPLICATE, will cause every selected vertex, edge and face to be duplicated. The duplicate is produced at exactly the same location as the original, so it won't be visible. If you use the Grabber to move the original version (since it is selected), then the copy will be revealed. The copy is created in an unselected state. You can use this command like a brush in a paint program, to scatter duplicate objects wherever you please.

Working with the Disk

You have already used the commands to load and save scenes and images. A scene can contain objects, which are made up from vertices, edges and faces. In addition a scene can contain the specifications for one or more lamps. A scene also can include some details about the observer, such as the location and target position. Finally a scene can contain the parameters for the world, that is to say the ground and the sky.

When you load or save a scene you will be asked which of these components that you wish to deal with. If you wish you may choose to load the objects from one file and the lamps from another.

If you are saving a scene, you have one additional choice. If you decide to save the objects, you can restrict yourself to only those objects that are selected.

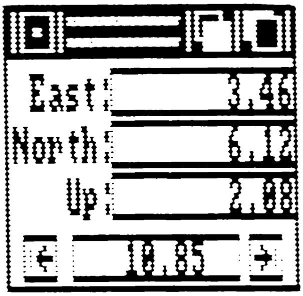
Saving and Loading Objects

Although the EDIT ADD group of commands provides a variety of primitive objects, the time will come when you wished it had others. If you build an object, then you can save it on the disk with the PROJECT SAVE SCENE command. Instead of saving it this way, you can also save it with the PROJECT SAVE OBJECT command. This command has two differences compared with PROJECT SAVE SCENE. You are not given the opportunity to save anything other than selected objects. The positions of the objects are saved relative to the cursor position.

The corresponding command, PROJECT LOAD OBJECT restores the object to the Tri-View at a position relative to the cursor location. For example, suppose that you had constructed a model of a grand piano, and all the vertices were selected, then you could position the cursor under one leg and save the object to a disk file. If, at another session, you wished to introduce a grand piano into a scene, you could move the cursor to the place where you wanted the leg of the piano to be and execute the PROJECT LOAD OBJECT.

If you need numerous copies of the same object, it is easier to use the EDIT ADD DUPLICATE command to copy them and then drag them to the new location, than to load them from disk each time.

The Coordinates Window


East: 3.46
North: 6.12
Up: 2.08
10.85

The Coordinates Requester

Up until now, we have been building shapes in a free form manner, without regard to actual measurements and exact shapes. If you execute the command EDIT COORDINATES, a new window will pop up. You can drag it to a location where it will not obstruct the Tri-View.

When you invoke this window, a requester will ask you how many decimal places you wish to work with. SCULPT 3-D has its own natural system of measurement, but it translates this into a more suitable form for you and displays the results in the window.

The window displays the cursor position relative to the observer's target. This is represented as a distance east, a distance north and a distance in an upward direction from the target.

If you are building an object from a set of plans, it is a good idea to move the target to a convenient location. For example place the target at one corner of a house. The numbers in the coordinates window can directly correspond to measurements on the plans. If you are building a complicated object from many simpler ones, build each one at the target and then use the Grabber to transport them to their final location.

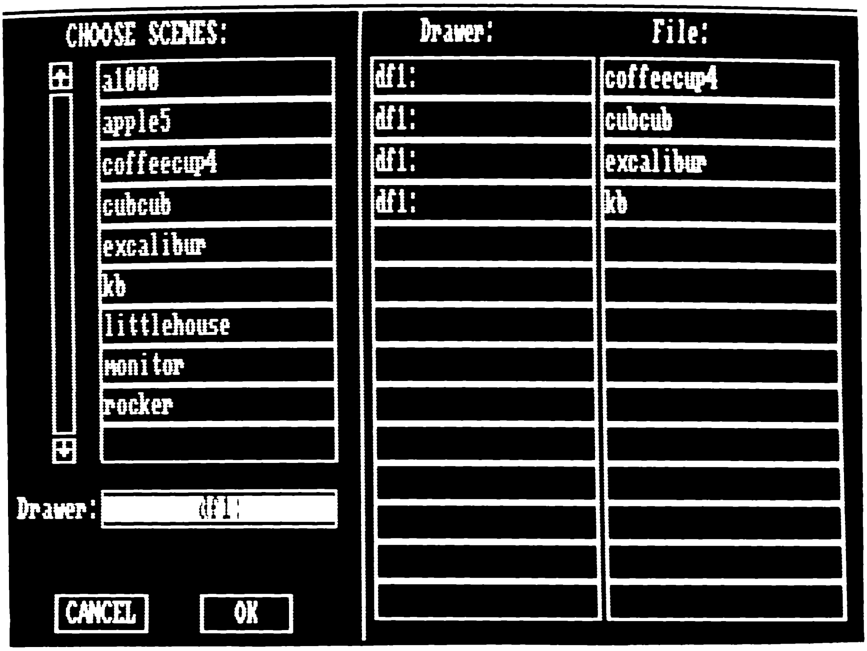
The fourth number that is displayed is the readout from an automatic tape measure. The two gadgets on either side set the two ends of the tape. To fix an end of the tape measure at a particular location, move the cursor there and click on one of the gadgets. As soon as both ends of the tape are specified, you will see the distance between them displayed in the window. One or both ends can be attached to a vertex. To do this, move the cursor to the vertex and click the tape end gadget. If the vertex moves, the measurement will change.

The positions of the ends of the tape are shown by small icons in the Tri-View. The icon is purple if it is attached to a vertex, otherwise it is blue.

When you are working with the coordinates window, you may have trouble getting the exact measurements that you need. The number may jump from 99. 7 to 100. 2 and no amount of careful mouse movement will get to 100. 0. If this happens, use the Center Tri-View Gadget to move the Tri-View so that the cursor is centrally positioned. Then use the Contract Tri-View Gadget to zoom in closer. You will find that the mouse is now able to position things much more exactly and you will be hitting your measurements right on the nose.

Unattended Operation

If you have attempted to make images of complicated objects, you will be aware that considerable amounts of computer time may be required. SCULPT 3-D has an unattended mode of operation that enables you to prepare a number of scenes and then have an image generated for each one. Execute the command PROJECT BATCH. A requester similar to the load scene requester will pop up. The requester is divided into two regions. The left half of the requester operates as usual allowing you to select drawers and files. Instead of displaying the file name in the FILE box, both the file name and the drawer name are copied across to the list on the right.



The Batch Requester

You can specify up to 14 scene names and when you hit the OK button, SCULPT 3-D clears the Tri-View and loads the first scene. It then generates an image and saves the image on the disk. This is repeated for each scene on the list. You must ensure that you have enough disk space to receive all the images that you plan to make. You must also ensure that you do not already have image files with the same names as your scene files since BATCH mode uses the scene filename and appends a ".image" suffix to it.

Controlling SCULPT 3-D with Scripts

Although SCULPT 3-D draws much of its power from its interactive nature, there may be occasions when you wish to work with data generated by another program, or with objects that are difficult to construct with the power tools provided.

Almost all of the features of SCULPT 3-D can be controlled by script commands. A special file that contains the commands must be prepared using a text editor program. The file name should end with the characters ".script". The commands are started by issuing the menu command PROJECT LOAD SCRIPT. A requester will pop up to permit you to specify the file.

The syntax of script commands closely follows that of the menu commands. The only features of SCULPT 3-D that are not available are those that require interaction with the user and which do not make sense in a script driven system. For complete details on the script commands, consult the appendix.

If you are a computer programmer, you can write a program to generate script files. Scripts can be prepared to construct objects that would otherwise be difficult to build, for example a threaded bolt.

CHAPTER 6

This chapter discusses the world in which SCULPT 3-D objects reside. Facilities are described for lighting a scene and providing a ground and sky.

Creating Lamps

The shadows, highlights and subtle nuances of shading that give SCULPT 3-D images a sense of reality depend upon the illumination of the scene. In Chapter 3 we introduced the EDIT LAMPS CREATE command that placed a lamp at the current cursor position. The lamp is depicted in the Tri-View as a white star.

There is no limit to the number of lamps that can be created, but since each additional lamp increases the amount of computation to generate an image, it is wise to try to use as few as possible.

For dramatic effects, you can employ colored lighting. In order to create a colored lamp, you must first use EDIT LAMPS COLOR. This command calls up a requester similar to the one you used to set the current object color. Set the sliders to pick the color that you desire. There is no need to dim the light with the V slider. Instead you can use the EDIT LAMPS BRIGHTNESS command. This invokes a requester that permits you to state how bright you want the lamps to be. Think of this number as the wattage of the lamp. You do not have to worry about the overall brightness of the scene. SCULPT 3-D has an automatic exposure control that handles that.

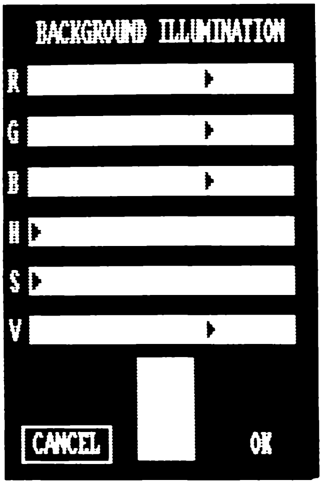
In SCULPT 3-D, as in the real world, the brightness of a lamp falls off according to the inverse square law. This means that if you quadruple your distance from the light, the intensity falls to one sixteenth of its original value. If you place a lamp close to an object, more distant parts of the scene may be very dimly lit. Unless you want to create some special effect, you should place your lamps at a distance from the target that is five or ten times larger than the distance from the observer to the target.

If you wish to change the brightness or color of a lamp, you must change the current color or brightness and move the cursor to the position of the lamp and then issue the command EDIT MODIFY INDICATED LAMP COLOR or MODIFY INDICATED LAMP COLOR.

Alternatively, you may change the color or brightness with the commands EDIT MODIFY COLOR OF ALL LAMPS or EDIT MODIFY BRIGHTNESS OF ALL LAMPS.

Illumination

SCULPT 3-D employs a technique called the low albedo approximation, when it generates an image. This means that any part of an object that is shaded from all light sources is totally dark, and does not pick up reflected light from nearby illuminated objects. In order to soften the shadows, SCULPT 3-D allows you to specify a diffuse ambient illumination that is independent of the lamps that you create.



The Background Illumination Requester

You can change the amount of the illumination with the command WORLD.ILLUMINATION. This brings up an illumination color requester that you operate in the same way as other color requesters.

requester that you operate in the same way as other color requesters. Unlike the lamps, there is no separate brightness facility for controlling the intensity of the ambient illumination, so you must do this entirely with the V slider. Usually the V slider should be set about one quarter of the way from the left.

If the illumination value is made too large, images will seem flat and lifeless. Too small a value will make shaded faces look unnaturally dark.

The Sky

You will have noticed that SCULPT 3-D places a blue background behind the images of the objects that you construct. This background, although it is called the sky, need not be blue. Execute the menu command WORLD SKY and you will see a color requester pop up. The SKY requester has a couple of extra gadgets. The one at the top probably contains the word GRADUATED. This gadget is a three-way toggle. Click on it a few times and watch it change from GRADUATED to NONE and SOLID before repeating the cycle.

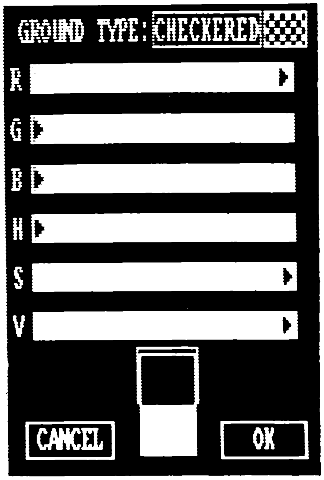
If you select NONE, there will be no sky, and the background will be black. Notice that the color swatch shows black, despite the settings of the sliders. Now select SOLID, and see that the swatch displays the color set by the sliders. If the sliders are moved, the swatch changes color normally. If you make an image, then the background color will be the one that you have selected.

Select GRADUATED, and notice that the swatch has an extra border around part of the perimeter. If the border surrounds the top half of the swatch, the sliders only change the color in the top half of the swatch. Now click on the swatch. The border should jump from the top of the swatch to the bottom, or vice versa. By selecting which half of the swatch is selected by the border, you can set up two entirely different colors. The upper color represents the color at the zenith, or directly overhead. The lower color represents the color at the horizon.

If you make a picture with a GRADUATED sky and use SNAPSHOT or PHOTO mode, the sky color will blend smoothly between the ones that you have selected. In PAINTING mode, the color of the sky will be the zenith color.

The Ground

If you wish to depict a scene where the objects are not floating freely in space, but are sitting securely on the ground, then you must make a model of the ground. If the ground is flat, then a single triangular face may be employed. Make it a few hundred times bigger than the scale of the other objects, and it will seem to stretch off to infinity.


GROUND TYPE: CHECKERED

The Ground Requester

Alternatively, you can use the ground plane that is built into SCULPT 3-D. To use it, execute the command WORLD GROUND. A color requester will be invoked. Like the sky color requester, it has a ground type gadget near the top right. By clicking on it, it can be toggled between NONE, SOLID and CHECKERED.

If NONE is selected, then no ground is produced. Otherwise an infinite ground plane is generated that passes through the Origin. The Origin is the center of the SCULPT 3-D universe, and it is where the observer target is initially placed. If ground exists, and it passes through the Tri-View, it is displayed as a horizontal line in two of the windows. If you enable the ground, and yet don't see it in a Tri-View window, it is because the Tri-View volume is too far

If you select a SOLID ground, then it will be uniformly colored and you can use the sliders to pick a color. If you select CHECKERED, then the swatch divides into two and you can select two colors, just as you did for the sky. A checkered ground plane is one where alternate squares on the ground are different colors, like the squares on a chess board. The size of the squares can be specified by clicking on the icon just to the right of the word CHECKERED. This sets the size of each square to be the same as the maximum dimension of the Tri-View volume.

Although a checkered ground plane has become something of a cliche in computer generated images, it does give an enhanced illusion that the ground extends to infinity. In addition, it adds interest to scenes that contain mirrored objects, for the reflections of the checkered ground make it easier for the eye and brain to perceive the shape of a mirrored object.

CHAPTER 7

This chapter discusses techniques for making and manipulating complicated objects. It also discusses problems that can arise due to the limitations of working with a two dimensional screen and a finite memory size.

Wire Frame Techniques

There are two approaches to using the Tri-View. You can use three small windows that you can see simultaneously. When SCULPT 3-D is started, the Tri-View windows are arranged in this way. This is probably the best configuration to use while you are mastering SCULPT 3-D, and as long as the scenes that you create are relatively simple, this is the recommended way of working with the wire frame model.

When you are building really complicated objects it is better to expand each Tri-View window as much as possible, and stack them one on top of another. Working in the larger window is much easier, but since you can only see one view at a time, it is harder to see what is going on. You will have to use the back gadget to push back the current window to reveal another.

When you are constructing an object in the Tri-View there are usually several ways to reach the same goal. The low level approach of working with single vertices is seldom recommended except for modifying local regions.

If your subject has any symmetry, make use of it and use the spin command or the extrude tool. Never hesitate to build an object in several pieces and assemble them by superimposing. Take a look at some of the example scenes that were supplied with SCULPT 3-D. Try executing an EDIT SELECT CONNECTED command on a sample vertex. If less than the entire object is selected, use the Grabber tool to pull the selected portion to one side. Then repeat the process on what remains of the object. You may find that a single complicated shape is made up of numerous simpler pieces.

The edges of the Tri-View can be used as a ruler to ensure that the cursor moves in a straight line. For example, suppose that you wanted to produce a vertical tube with a complicated cross section. The outline could be constructed in the 'down' window using the curve tool. Move the cursor to the left edge of one of the other windows. Select the extrude tool and drag the cursor down the left edge. This ensures that extrusion takes place exactly in a vertical direction.

Sometimes it is useful to place an isolated vertex as a marker in the Tri-View. An edge can be constructed between two vertices to serve as a straight edge for further construction.

Multiple Use of the Extrude Tool

The extrude tool described in Chapter 4 was used to make simple cookie cutter shapes. It can be used as a much more powerful tool when it is used repeatedly.

As an example, let us construct a long cylinder with a 90 degree rounded corner. This is much easier to demonstrate than explain, so you should follow through on the computer in order to see what is happening.

Clear the Tri-View. Activate the down window by pointing to it and pressing the left mouse button. Add a tube. The tube will be squat but it should be pointing in the upward direction. Select all the vertices. Use the EDIT DO EXPAND command to shrink the diameter of the tube. This requires that the expansion gadget in the up-down direction is turned off. Reduce the diameter of the tube to one quarter of its original size.

Expand the Tri-View three times. Switch to the north window and move it downwards until the top of the tube extends beyond the top of the window. Deselect the vertices that make up the bottom of the tube. Move the window upward until the bottom of the tube is at the bottom of the window. The vertices at the top of the tube should be selected.

Move the cursor so that it is to the left of the cylinder, but level with the top. This will be the center of curvature for the bend that we are going to make. Do not move the cursor until the bend is complete.

Select the extrude tool and immediately drop it by pressing the right mouse button. Press the rotate gadget twice in the north window. You will have produced a 10 degree elbow in the cylinder. Repeat the sequence of selecting the extrude tool, dropping it and rotating the selected cross section, eight more times and you will have finished the 90 degree bend.

When the bend is complete the cursor can be moved to the top right corner of the window and the extrude tool selected. Slide the cursor to the left to pull out the horizontal part of the tube. Drop the extrude tool and the construction is complete.

Working from Plans

When you are working from a set of plans, or require to produce an object with a specified size or shape, the coordinate window should be opened. By using the observer's target as a temporary origin, it is often possible to enter vertices into the Tri-View directly from measurements in the plans.

Even when plans are not used, it is often a good idea to make a rough drawing on squared paper and use this, in conjunction with the coordinate window, rather than relying totally with free form construction with the mouse.

Improving Performance

The drawback of using intersecting solids is that computing resources are wasted if a face is entirely inside another volume, and can never be seen. Such faces can be deleted to improve performance.

Any faces that do not contribute to the image can be deleted, with a resulting increase in performance. If you are using PHOTO mode, be sure that the faces do not contribute to a shadow, even if they are not visible. If you have any mirrored surfaces, ensure that the faces that are erased do not contribute to a reflection. Generally it is possible to effect substantial speed improvements by intelligently pruning parts of a scene.

Superimposed Vertices

If two or more vertices occupy the same location, SCULPT 3-D will seem to behave strangely. The SELECT CONNECTED command may seem to refuse to select anything but the indicated vertex. In this case the offending vertex may be erased.

Memory Usage

If your model is so complicated that it threatens to use up almost all the memory of the Amiga, you should take care not to initiate an extra task from the workbench. When the grinding gear wheels image is replaced by the regular pointer, but the image is still being generated, do not start modifying the contents of the Tri-View.

While you are working with the Tri-View, make a habit of regularly saving the scene to disk. The small time that this takes is a valuable insurance for the time that has been expended building a complicated model.

Conclusion

Now that you have mastered SCULPT 3-D you can use the reference manual in the appendix if you forget how a particular command works.

The scenes that you can build with SCULPT 3-D are limited only by your imagination and the amount of memory on your Amiga. Enjoy the product and enrich the world with your creations!

APPENDIX

A REFERENCE MANUAL FOR SCULPT 3-D

THE GEOMETRY OF SCULPT 3-D

The Tri-View is a rectangular block of space that is represented by three windows showing wire frame projections of the contents of the Tri-View. The size and shape of the Tri-View may be changed.

The geometry of surfaces is defined by vertices, edges and faces. A vertex is a single point in space. It may be selected or unselected. Vertices are never visible in the images, but are displayed in the Tri-View either as purple for unselected vertices or yellow for selected vertices.

An edge may be created between two vertices. An edge is displayed in the Tri-View as a dark line. Edges are not displayed in images. An edge is considered to be selected if both its vertices are selected.

A face is created whenever three vertices are joined by three edges so each face is triangular. Faces are not explicitly shown in the Tri-View but they are displayed in the images generated by SCULPT 3-D. Faces have a specified color, texture and smoothness. The color is defined by the reflection coefficients for red, green and blue light. The coefficients range from zero to one hundred percent. The texture may be either dull, shiny or mirror finish. If a face has the smoothness property, it is shaded as if it is curved so as to blend with adjacent faces.

The location of the observer in the Tri-View is shown by a small blue circle. The position of the observer's target is shown by a small blue x. The position of any lamps are shown by a small white star.

THE TRI-VIEW GADGETS

DRAG BAR GADGET

This is a standard Intuition gadget located in the upper border of each window. It is used to drag the window to a new location on the screen.

THE BACK GADGET AND THE FRONT GADGET

These are standard Intuition gadgets that change the depth arrangement of windows on the screen.

THE REVERSE GADGET

This reverses the viewing direction of a Tri-View window. The first window is normally a downward view. Pressing this gadget will make it an upward view. This is achieved by replacing the contents of the window by its mirror image, thus the first window will have east on the left and west on the right.

THE MOVE TRI-VIEW GADGETS

These gadgets are located in the center of each border and cause the Tri-View to move in the indicate direction. The effect is to make the contents of the Tri-View move in the opposite direction. Holding down the left Amiga key while using a Move Gadget causes the size of the move to be smaller than usual. If the right Amiga key is depressed, the Move Gadget moves the Tri-View further than usual.

THE EXPAND TRI-VIEW GADGET

This gadget causes the Tri-View to expand. If it is used with the left Amiga key, the expansion is small. If it is used with the right Amiga key, the expansion is large.

THE SIZING GADGET

This is a standard Intuition gadget for changing the size of a Tri-View window. Since each window represents a block of space, changing one window's size will result in one or more other windows changing size also.

THE CONTRACT TRI-VIEW GADGET

This gadget causes the Tri-View to contract. If it is used with the left Amiga key, the contraction is small. If it is used with the right Amiga key, the contraction is large.

THE CENTER TRI-VIEW GADGET

This gadget causes the Tri-View to move so that the cursor is left in the center of the Tri-View.

THE GRABBER GADGET

This gadget can be toggled on or off. If the Grabber is on, all the selected vertices will move when the cursor is moved. The Grabber is always turned off when the right mouse key is pressed to pull down a menu. When the Grabber is active, the icon for the cursor shows a small Grabber tool on the upper crosshair.

THE EDGE BUILDING GADGET

If either two or three vertices are selected, then edges are constructed between the selected vertices. If nothing happens when you use this gadget, except that the screen flashes at you, it means that there are more than three selected vertices. Perhaps the extra vertices are outside the Tri-View, or you may have two vertices occupying the same position, both selected.

THE SELECT GADGET

This gadget changes the selection state of all vertices within the Tri-View. If one or more vertices in the Tri-View are selected, then they are unselected. If no vertices in the Tri-View are selected, then all the vertices in the Tri-View are selected. In either case, the state of vertices outside the Tri-View are unchanged.

THE ROTATE GADGETS

These gadgets cause selected vertices to rotate about the cursor in the indicated direction. Normally the vertices are rotated by 5 degrees for each click on the gadget. If the left Amiga key is held down, then the rotating is by one degree. If the right Amiga key is held down then the rotation is by 45 degrees.

NON-STANDARD USE OF THE MOUSE BY THE TRI-VIEW

When the left mouse button is pressed down, and the pointer is over a Tri-View window, then the current tool is dragged by the mouse. Special actions take place when a specific tool is picked, see the descriptions for TOOLS SELECTOR, TOOLS DESELECTOR, TOOLSMAGNET, TOOLS CURVE and TOOLS EXTRUDE for more details. When the default tool is active, the cursor is represented by a blue cross and the following actions happen:

If the left mouse button is pressed, the cursor is moved to the pointer position. If the left button is held down while the mouse is moved, then the cursor will move.

If the right mouse button is pushed while the left button is held down, then a new vertex is created at the cursor position.

If the cursor is moved very close to a vertex in one window of the Tri-View, and the left mouse button is double clicked, the vertex will be selected if it was unselected, or vice versa. The cursor will snap to the location of the vertex in the other two windows.

If an image is being displayed on the screen, it may be pushed behind the Tri-View screen by first clicking on the image. The pointer will disappear. If the right mouse button is pressed, the image will be pushed behind the Tri-View screen.

MENU COMMANDS

PROJECT LOAD SCENE

This command invokes a file requester that displays the names of files that contain scenes. If more than ten files are found, only ten are displayed. You may use the scroll bar and scroll gadgets to search for a file. If you click on a file name, the name will be copied into the file name gadget. Alternatively you may click on the file name gadget and enter the name directly from the keyboard. You may enter text into the drawer name gadget. Upon pressing the carriage return, the list of files will be changed to reflect the new drawer. If the cancel button is selected, no action is taken. If the OK button is selected, SCULPT 3-D searches for a file with a name obtained by combining the drawer name and the file name.

When the file has been opened a requester pops up asking which portions of the file are to be loaded. A scene may contain data on objects, lamps, the observer or the world. Click on the boxes to toggle them between YES and NO to specify which parts of the file are to be loaded. Click on the OK button to start loading.

Any objects or lamps that are loaded will be added, pre-existing lamps or objects will be retained. If an observer or world is loaded, these attributes will override any existing observer or world attributes.

PROJECT LOAD IMAGE

This command invokes a file requester and displays the names of files that contain images. If more than ten files are found, only ten are displayed. You may use the scroll bar and scroll gadgets to search for a file. If you click on a file name, the name will be copied into the file name gadget. Alternatively you may click on the file name gadget and enter the name directly from the keyboard. You may enter text into the drawer name gadget. Upon pressing the carriage return, the list of files will be changed to reflect the new drawer. If the cancel button is selected, no action is taken. If the OK button is selected, SCULPT 3-D searches for a file with a name obtained by combining the drawer name and the file name. The specified image is displayed, replacing any existing image.

PROJECT LOAD OBJECT

This command invokes a file requester and displays the names of files that contain scenes. If more than ten files are found, only ten are displayed. You may use the scroll bar and scroll gadgets to search for a file. If you click on a file name, the name will be copied into the file name gadget. Alternatively you may click on the file name gadget and enter the name directly from the keyboard. You may enter text into the drawer name gadget. Upon pressing the carriage return, the list of files will be changed to reflect the new drawer. If the cancel button is selected, no action is taken. If the OK button is selected, SCULPT 3-D searches for a file with a name obtained by combining the drawer name and the file name.

Any objects that are found in the file are loaded at a position relative to the cursor.

PROJECT LOAD SCRIPT

A requester will pop up that asks for the name of a file containing script commands. SCULPT 3-D will execute the script commands, before returning control to the mouse driven interface. If a syntax error is detected, you are given the choice of continuing, or halting the execution of the script. A full list of script commands is given later in this appendix.

PROJECT SAVE SCENE

This command causes the current scene to be written to the disk. A requester pops up to solicit the name of a drawer and a file. If the OK button is pressed, the two names are combined to produce a new name. If the new name already exists as a file, a requester will pop up to warn you that you will overwrite the contents of the file if you continue.

A requester will then pop up asking which parts of a scene are to be saved. You may click on the boxes to toggle them from YES to NO. In addition you may specify if all objects are to be saved, or only the selected objects. Click on the box to toggle it between ALL and SELECTED. If the OK gadget is selected, the specified parts of the scene will be written to the file that was named earlier.

PROJECT SAVE IMAGE

This command is only available if an image has been made, but has not been aborted. It causes the current image to be written to the disk. A requester pops up to solicit the name of a drawer and a file. If the OK button is pressed, the two names are combined to produce a new name. If the new name already exists as a file, a requester will pop up to warn you that you will overwrite the contents of the file if you continue.

PROJECT SAVE OBJECT

This command causes selected objects to be written to the disk. A requester pops up to solicit the name of a drawer and a file. If the OK button is pressed, the two names are combined to produce a new name. If the new name already exists as a file, a requester will pop up to warn you that you will overwrite the contents of the file if you continue.

When the objects are written to the disk, their positions are taken to be relative to the cursor.

PROJECT BATCH

This command invokes a file requester that displays the names of files that contain scenes. If more than ten files are found, only ten are displayed. You may use the scroll bar and scroll gadgets to search for a file. If you click on a file name, the name of the file and the current drawer will be copied into the list at the right of the requester. You may enter text into the drawer name gadget. Upon pressing the carriage return, the list of files will be changed to reflect the new drawer. If the cancel button is selected, no action is taken. If the OK button is selected, SCULPT 3-D erases the Tri-View, reads the specified scene, generates an image using the observer parameters that are a part of the scene and saves the image under the same name as the scene. This operation is repeated until all the specified files have been processed.

PROJECT ABOUT

The version number and other information about SCULPT 3-D is displayed.

PROJECT QUIT

After verifying that this is your intention, SCULPT 3-D stops operating and returns control to the workbench or CLI.

EDIT SELECT ALL

All vertices, and hence all edges and faces, become selected.

EDIT SELECT CONNECTED

All vertices that are connected, directly or indirectly, to the indicated vertex become selected. If a vertex lies within a few pixels of the cursor in the active window of the Tri-View, this vertex is considered the indicated vertex. If more than one vertex meets this criteria and they are distributed in depth, then the indicated vertex is the one that is closest to the cursor in the depth direction.

EDIT DESELECT ALL

All vertices, and hence all edges and faces become unselected.

EDIT DESELECT CONNECTED

All vertices that are connected, directly or indirectly, to the indicated vertex become unselected. If a vertex lies within a few pixels of the cursor in the active window of the Tri-View, this vertex is considered the indicated vertex. If more than one vertex meets this criteria and they are distributed in depth, then the indicated vertex is the one that is closest to the cursor in the depth direction.

EDIT ERASE SELECTED VERTICES

All selected vertices are erased. Any edges and faces that are defined by these vertices are also erased.

EDIT ERASE SELECTED EDGES

All selected edges are erased. Any faces that are defined by these edges are also erased. A selected edge is one that has a selected vertex at each end.

EDIT ERASE INDICATED VERTEX

The indicated vertex is erased. If a vertex lies within a few pixels of the cursor in the active window, this vertex is considered the indicated vertex. If more than one vertex meets this criterion, then the one closest in depth to the cursor is the indicated vertex.

EDIT ERASE INDICATED EDGE

The indicated edge is erased. If an edge passes within a few pixels of the cursor in the active window, this edge is considered the indicated edge. If more than one edge meets this criterion, then the one closest in depth to the cursor is the indicated edge.

EDIT ERASE INDICATED LAMP

The indicated lamp is erased. If a lamp lies within a few pixels of the cursor in the active window of the Tri-View, this lamp is considered the indicated lamp. If more than one lamp meets this criteria and they are distributed in depth, then the indicated lamp is the one that is closest to the cursor in the depth direction.

EDIT ERASE ALL LAMPS

All lamps are erased.

EDIT ERASE ALL

All vertices, edges and lamps are erased.

EDIT DO EXPAND

A requester is invoked that can be used to expand the set of selected vertices. The expansion (or contraction) is uniform in the selected directions and is directed away from the centroid of the selected vertices.

The expansion can take place in the north-south direction or the east-west direction, or the up-down direction, or any combination selected by the buttons on the requester. Expansion may be in discrete stages by factors of 2 or 1/2 by pushing the appropriate buttons. Alternatively the upper slider may be used. Moving it to the right of center causes expansion, left of center causes contraction. The lower slider may be used for fine adjustment. It is 50 times less sensitive.

The expansion requester may be dragged to a new location so that it does not obstruct the Tri-View. The drag bar is at the top of the requester. If the CANCEL button is pressed, the vertices revert to their positions before the expansion was attempted.

EDIT DO BE SPHERE

The cursor must be placed over a vertex. The vertices that are connected to this vertex are examined and the size of a rectangular box that would just contain the vertices is determined. The vertices are moved radially from the center of the box until they lie on the surface of a sphere whose diameter is equal to the longest side of the box.

The effect of this command is to make an object approximate a sphere. The approximation will be quite good if the object has many faces.

EDIT DO SUBDIVIDE

This operation divides each selected edge into two. Additional edges are created to ensure that subdivided faces remain triangulated. The effect is that faces that are selected are split into four, while faces that have two selected vertices are divided into two.

EDITDO SPIN

The spin operation takes place in the active Tri-View window. Each selected edge is swept around the spin axis creating new faces. Each selected vertex is swept around the spin axis creating new edges. The spin axis is horizontal on the screen and passes through the cursor position.

Normally the spin operation is applied to a sequence of connected edges created with the curve tool. It then produces a surface of revolution about the horizontal axis.

EDIT DO FILL

In order for this command to operate, the selected vertices must all lie on a single plane. In addition the selected edges must form one or more closed loops. The loops must not intersect one another. The FILL command constructs new edges so that the interior of each loop is fully triangulated. If one loop lies entirely inside another, then that loop is regarded as a hole for the purpose of filling. For example, if the fill command is applied to two concentric circular loops, a filled annulus will be produced.

EDIT DO UNSLICE

This command treats the selected vertices as slices through an object. All selected vertices must be members of closed loops. Each loop must lie in a plane. All the planes must be parallel. The loops are connected to approximate the object defined by the slices.

EDIT ADD DUPLICATE

Each selected vertex and edge is duplicated. The duplicates are created in an unselected state. The duplicates occupy the same positions as the original, so they are not visible unless the Grabber is used to move the originals to a new location. This command may be used repeatedly as the original object is dragged from one location to another, in order to create multiple copies of the object.

EDIT ADD SPHERE

Add a pseudo-spherical polyhedron. A requester asks how many subdivisions of an icosahedron are required. A value of zero yields a regular icosahedron with 20 faces. Each extra subdivision quadruples the number of faces, so storage can easily be exceeded. If smoothing is enabled, even a coarse figure looks quite spherical.

The size of the sphere is chosen to fit inside the current Tri-View volume with a small clearance.

EDIT ADD HEMISPHERE

Add a pseudo-hemispherical polyhedron. A requester asks how many times the basic polyhedron is to be subdivided.

EDIT ADD CUBE

A Cube is constructed whose size is chosen to fit inside the current Tri-View volume with a small clearance.

EDIT ADD PRISM

A prism is constructed whose size is chosen to fit inside the current Tri-View volume with a small clearance.

EDIT ADD DISK

A disk shaped triangulated polygon is added. A requester asks for the number of sides of the bounding polygon.

EDIT ADD CIRCLE

A regular polygon is added to the Tri-View. A requester asks for the number of sides for the polygon.

EDIT ADD CYLINDER

A polyhedral approximation to a closed cylinder is added to the Tri-View. A requester asks for the number of sides at each end.

EDIT ADD TUBE

An approximation of a tube with circular cross section is added to the Tri-View. A requester asks for the number of sides at the end of the tube.

EDIT ADD CONE

A polyhedral approximation to a closed cone is added to the Tri-View. A requester asks for the number of sides for the base.

EDIT MODIFY COLOR OF SELECTED FACES

The color of each selected face is changed to the current color.

EDIT MODIFY TEXTURE OF SELECTED FACES

The texture of each selected face is changed to the current texture.

EDIT MODIFY SMOOTHING FOR SELECTED FACES

The state of smoothing (enabled or disabled) of each selected face is changed to agree with the current smoothing value.

EDIT MODIFY INDICATED LAMP COLOR

The color of the lamp that is indicated by the cursor is changed to the current lamp color.

EDIT MODIFY INDICATED LAMP BRIGHTNESS

The brightness of the lamp that is indicated by the cursor is changed to the current lamp brightness.

EDIT MODIFY COLOR OF ALL LAMPS

The color of all the lamps is changed to the current lamp color.

EDIT MODIFY BRIGHTNESS OF ALL LAMPS

The brightness of all the lamps is changed to the current lamp brightness.

EDIT COLOR

A requester is displayed to enable the current color for faces to be changed. The color may be changed by using sliders to set the red, green and blue values. Alternatively, sliders can control the hue, saturation and value. Hue varies continuously from red to green to blue and back to red. Saturation represents the purity of the color. As the saturation is decreased, more white is mixed in. The value is a measure of the brightness of the shade.

The current color is used each time a face is created. It is also used whenever selected faces are modified with the EDIT COLOR OF SELECTED FACES command.

The FETCH gadget may be used to extract the average color of selected faces.

EDIT TEXTURE DULL

This command sets the current texture to DULL. A dull face reflects light uniformly in all directions. The effect is like that of flat paint. The current texture is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY TEXTURE OF SELECTED FACES command.

EDIT TEXTURE SHINY

This command sets the current texture to SHINY. A shiny face reflects most of the light uniformly in all directions, but a small amount is reflected as though from a mirror. The effect is like that of glossy paint in that the surface may produce a glint if it is at just the correct angle to the light sources. The current texture is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY TEXTURE OF SELECTED FACES command.

EDIT TEXTURE MIRROR

This command sets the current texture to MIRROR. A mirrored face reflects light like a colored mirror. The current texture is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY TEXTURE OF SELECTE FACES command.

EDIT TEXTURE LUMINOUS

This command sets the current texture to LUMINOUS. A luminous face reflects no light, but emits light specified by the color of the face. The current texture is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY TEXTURE OF SELECTED FACES command.

EDIT SMOOTHING ON

The current smoothing state is turned on. If a face exhibits smoothing, then the shading of the face will make the face seem curved in order to blend with adjacent faces. The face is really still flat, however, as can be seen if the face is seen edge on. The current smoothing value is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY SMOOTHING FOR SELECTED FACES command.

EDIT SMOOTHING OFF

The current smoothing state is turned off. If a face is without smoothing it appears flat and does not blend with adjacent faces. The current smoothing value is applied to each newly created face.

It may also be applied to selected faces with the EDIT MODIFY SMOOTHING FOR SELECTED FACES command.

EDIT LAMPS CREATE

A lamp is created at the cursor position. Its brightness will be the current lamp brightness and its color will be the current lamp color. At least one lamp must be created in order to obtain an acceptable image.

EDIT LAMPS BRIGHTNESS

This command invokes a requester for the current lamp brightness. The number that is entered must be an integer. Absolute values do not matter, only relative values from one lamp to another. SCULPT

3-D has an automatic exposure system to compensate for changes in total brightness.

EDIT LAMPS COLOR

A color requester will be produced. Operate it in the same manner as the requester from EDIT COLOR. It is used to set the value of the current lamp color. There is no advantage in setting the V value at any but the far right value. Use the EDIT LAMPS BRIGHTNESS command to vary the power of a lamp.

EDIT COORDINATES

This command causes a coordinate window to pop up. Before the window is displayed, a prompt is given for the location of the decimal point for numerical values. This window can be dragged to any part of the screen and depth arranged. The window can be removed with its close gadget. The window displays the current position of the cursor measured eastward, northward and upward of the observer's target.

In addition, the window also displays the distance between two selected points. These points can be set by using the End Point Gadgets. If an End Point Gadget is pressed, the end point is either the vertex indicated by the cursor, or the current cursor position. If a vertex is specified as an end point, then the end point moves if the vertex is moved. The end points are represented by end point icons in the Tri-View windows.

TOOLS SELECTOR

This command picks the selector tool. It is represented in the Tri-View by a yellow square. It represents a cube in space. Any vertices that enter the cube become selected. The tool may be dropped by pressing the right mouse button.

TOOLS DESELECTOR

This command picks the deselector tool. It is represented in the Tri-View by a purple square. It represents a cube in space. Any vertices that enter the cube become unselected. The tool may be dropped by pressing the right mouse button.

TOOLS MAGNET ATTRACT

The magnet tool is selected and is placed in attract mode. The tool is represented by an image of a horseshoe magnet. If the left mouse button is held down and the right mouse button is clicked, all selected vertices are moved towards the magnet. The strength of the attraction falls off inversely as the square of the distance between the vertex and the magnet, except when the vertex is very close to the magnet, when the attraction varies directly with the distance. The magnetic attraction is increased if the magnet is operated with the right Amiga key pressed down. The attraction is reduced if the left Amiga key is down when the magnet is operated. The tool may be dropped by pressing the right mouse button.

TOOLS MAGNET REPEL

The magnet tool is selected and is placed in repel mode. The tool is represented by an image of a horseshoe magnet. If the left mouse button is held down and the right mouse button is clicked, all selected vertices are moved away from the magnet. The strength of the repulsion falls off inversely as the square of the distance between the vertex and the magnet, except when the vertex is very close to the magnet, when the repulsion varies directly with the distance. The magnetic repulsion is increased if the magnet is operated with the right Amiga key pressed down. The repulsion is reduced if the left Amiga key is down when the magnet is operated. The tool may be dropped by pressing the right mouse button.

TOOLS CURVE

The curve tool resembles the cursor crosshairs except that the upper and right portions of the cursor are replaced by an icon of a pencil. When the curve tool is picked and the left mouse button is held down and the right mouse button is clicked, a new vertex is created and an edge is constructed from this vertex to the previous vertex, except if this is the first vertex made with this invocation of the curve tool. If the curve tool is indicating an existing vertex when the right button is clicked, then the previous vertex will be joined to the indicated vertex with an edge. The tool may be dropped by pressing the right mouse button or by the act of building an edge to an indicated vertex.

TOOLS EXTRUDE

The extrude tool first performs a fill operation, if possible. It then duplicates the selected object and joins the duplicate and the selected object. The Grabber tool is activated. If you move to another window and move the cursor, the selected object is dragged, while the duplicate is fixed. The effect is to extrude a two dimensional shape into a three dimensional solid. Remember to drop the Grabber when the extrusion is complete.

OBSERVER MODE PAINTING

This command sets the observer in painting mode. A painting is an image where each face is represented by a single color and no shading is portrayed across a face. Shadows are not rendered. The image is produced rapidly, and no significant speed improvement is achieved if the image size is reduced.

OBSERVER MODE SNAPSHOT

This command sets the observer in snapshot mode. A snapshot is a ray traced image that excludes the effects of shadows. The time taken to produce an image is proportional to the image size, so small images can be produced much more quickly than large images.

OBSERVER MODE PHOTO

This command sets the observer in photo mode. A photo is a ray traced image that includes the effects of shadows. The time taken to produce an image is proportional to the image size, so small images can be produced much more quickly than large images. Photos take longer to generate than snapshots.

OBSERVER LO-RES

This specifies that images are to made in Amiga low resolution mode with 320 pixels across the screen.

OBSERVER HI-RES

This specifies that images are to be made in Amiga high resolution mode with 640 pixels across the screen. If Hold and Modify (HAM) graphics are employed, low resolution is used.

OBSERVER NO-INTERLACE

This command specifies that images are to be produced without interlace, so that 200 pixels are used in the vertical direction.

OBSERVER INTERLACE

This command specifies that images are to be produced with interlace, so that 400 pixels are used in the vertical direction. Some screen flicker may be perceived with a regular monitor.

OBSERVER BIT PLANES

This command requests the number of bit planes that are to be used. The number of colors in an image are two raised to the power of the number of bit planes. If 12 or more bit planes are requested, you are asked whether an RGB file is to be created. A value of zero is used to indicate that the default number of colors is to be used.

OBSERVER LOCATION

The location of the observer is moved to the cursor position. The observer's location is portrayed in the Tri-View by a small blue circle.

OBSERVER TARGET

The observer's target is moved to the cursor position. The observer's target is portrayed in the Tri-View by a small blue x. The target position will be in the center of any images that are produced.

OBSERVER LENS NORMAL

This command sets the width of view to correspond to that of a 50mm lens on a 35mm camera.

OBSERVER LENS WIDEANGLE

This command sets the width of view to correspond to that of a 28mm lens on a 35mm camera.

OBSERVER LENS TELEPHOTO

This command sets the width of view to correspond to that of a 135mm lens on a 35mm camera.

OBSERVER LENS SPECIAL

This will invoke a requester for the focal length of a non-standard lens. Enter the value in millimeters. A small value, like 20, corresponds to a wide view, whereas a large number, like 100, corresponds to a narrow view where distant objects seem closer.

OBSERVER EXPOSURE AUTO

This command instructs SCULPT 3-D to determine the screen brightness automatically.

OBSERVER EXPOSURE MANUAL

This command overrides the automatic exposure setting. Numbers larger than 100 cause the image to be brighter, values less than 100 cause the image to be darker.

OBSERVER IMAGE SIZE TINY

This command causes subsequent images to by made that are 1/8 of the full screen size.

OBSERVER IMAGE SIZE SMALL

This command causes subsequent images to be made that are 1/4 of the full screen size.

OBSERVER IMAGE SIZE MEDIUM

This command causes subsequent images to be made that are half of the full screen size.

OBSERVER IMAGE SIZE FULL

This command causes subsequent images to be made that are the full screen size.

OBSERVER IMAGE SIZE JUMBO

This command causes subsequent images to be made that are larger than the full screen size.

OBSERVER ANTI-ALIASING NONE

No anti-aliasing is to be used.

OBSERVER ANTI-ALIASING GOOD

A simple anti-aliasing scheme is used that does not incur a large penalty in computing time.

OBSERVER ANTI-ALIASING BEST

An anti-aliasing scheme is used that will incur a moderate penalty in computing time.

OBSERVER TILT

A requester is summoned to obtain an angle that the image is to be rotated. A value of 90 can be used to produce vertical format images.

OBSERVER START

This command initiates image generation. When a photo or a snapshot is being generated,the grinding gear wheel icon vanishes after a short time and all SCULPT 3-D commands (except OBSERVER START) may be executed without changing the image as it is produced. The image screen can be pushed behind the Tri-View screen by clicking on the image first with the left button and then with the right button.

OBSERVER SHOW

If an image screen has been pushed behind the Tri-View screen by clicking on the image first with the left button and then with the right button, it can be recalled by executing this command.

OBSERVER ABORT

This command will terminate any image generation. If an image is displayed, the image will be permanently removed.

WORLD SKY NONE, SOLID, GRADUATED

This command invokes a sky requester, which closely resembles the color requester. The gadget at the top is a three way toggle that can take the values NONE, SOLID or GRADUATED. Click on the gadget to change its value. When NONE is selected, no sky is generated, and the color sliders are not used. If SOLID is selected, then a single color sky is produced, and the color sliders can be used to specify the color. If GRADUATED is selected, the swatch of color at the lower center of the requester splits in two. The upper half is the sky color at the zenith (directly overhead), while the lower half represents the color at the horizon. The two colors will be blended at intermediate elevations from the horizon. Either the upper or lower half of the swatch is emphasized with a three sided border. Click on the swatch to toggle the selection between the two halves. The color of the selected half can be changed with the sliders.

Note that when the PAINTING mode is specified, the sky is displayed in a single color.

WORLD GROUND NONE, SOLID, CHECKERED

This command invokes a ground requester, which closely resembles the color requester. The gadget at the top is a three way toggle that can take the values NONE, SOLID or CHECKERED. Click on the gadget to change its value. When NONE is selected, no ground is generated, and the color sliders are not used. If SOLID is selected, then a ground plane is created and the color sliders can be used to specify the ground color. If CHECKERED is selected, the swatch of color at the lower center of the requester splits in two. This represents the two colors of a checkerboard patterned ground plane. Either the upper or lower half of the swatch is emphasized with a three sided border. Click on the swatch to toggle the selection between the two halves. The color of the selected half can be changed with the sliders.

When CHECKERED is selected, the gadget resembling a checkerboard at the top right of of the requester becomes active. It is called the Checkerboard Scale Gadget. If this gadget is clicked, the size of squares that are generated on the ground is set equal to the longest dimension of the Tri-View volume.

If either a SOLID or CHECKERED ground is chosen, then a line representing the ground is drawn in two of the Ti-View windows.

WORLD ILLUMINATION

This command invokes a color requester that can be used to set the brightness and color for background illumination. This light source bathes the entire scene without casting shadows. Normally the V value should be set at about 1/4 to prevent shadows from being totally black. Too high a value, or the absence of lamps will result in a flat and lifeless image.

SCRIPT COMMANDS

The meaning of most of the script commands is the same as the corresponding menu commands. In the following list, the portions of the commands that are in lower case are optional. When you prepare a script file you may use either upper or lower case and you may abbreviate the commands fully, partially or not at all.

When the command requires the name of a file, the name must be enclosed in double quotes. The name must also have '.SCENE' appended if it is a scene, or '.IMAGE' appended if it is an image. The name must include the required directory path information. See "The AmigaDOS Manual" for full details. Some commands contain keywords that convey information if present, but are optional. They are enclosed in square brackets. If you supply none of the optional keywords, the is effect to perform the default action.

For example, the syntax

```
LOAd SCEne "filename" [LAMps] [OBServer] [WORld] [OBJects]
```

means that the command may be abbreviated to LOA SCE. The file name is mandatory and it must be enclosed in double quotes, for example

```
LOAD SCEN "df0:littlehouse.scene" objec
```

If neither LAMPS, OBSERVER, WORLD nor OBJECTS are specified, the default action is to load them all. Note that we have mixed upper and lower case and partially abbreviated SCENE and OBJECTS.The effect of the command is to load the objects in the file, but not the lamps and the world and observer information.

Several commands may be placed on a single line, and commands can be split so as to lie on two or more lines except that commands like LOAD SCENE that contain optional keywords must lie on a single line.

When the command syntax specifies '#', you must place a numerical value at that point.

The following is a complete list of script commands:

```
LOAd SCEne "filename" [LAMps] [OBServer] [WORld] [OBJects]
LOAd IMAge "filename"
LOAd OBJect "filename"
SAVe SCEne "filename" [LAMps] [OBServer] [WORld] [OBJects]
[SELected]
SAVE OBJect "filename"
QUIt
SELect ALL
SELect CONnected
DESelect ALL
DESelect CONnected
ERAse SELected Vertices
ERAse SELected Edges
ERAse INDicated Vertex
ERAse INDicated Edge
ERAse INDicated Lamp
ERAse ALL Lamps
ERAse ALL
DO EXPand # [NS] [EW] [UD]
DO SUBdivide
DO SPIn
DO FILl
DO UNSlice
DO REFlect
ADD DUPlicate
ADD SPHere # #
ADD HEMIsphere # #
ADD CUBE #
ADD PRISM #
ADD DISk # #
```

ADD CIRcle # #
ADD CYLinder # #
ADD TUBe # #
ADD CONe # #
MODify COLor of Selected Faces
MODify TEXture of Selected Faces
MODify SMOothing for Selected Faces
MODify INDicated Lamp Color
MODify INDicated Lamp Brightness
MODify COLor of ALL Lamps
MODify BRIghtness of ALL Lamps
COLor # # #
TEXture DULl
TEXture SHIny
TEXture MIRror
TEXture LUMinous
SMOothing ON
SMOothing OFF
LAMps CREate
LAMps BRIghtness #
LAMps COLor # # #
COOrdinates #
EXTrude
MODe PAInting
MODe SNApshot
MODe PHOto
MODe LO-res
MODe HI-res
MODe INTerlace
MODe NO-INTerlace
MODe BIT PLAnes #
LENs NORmal
LENs WIDeangle
LENs TELephoto
LENs SPEcial #
EXPosure AUTo
EXPosure MANual #
IMAge size TINy
IMAge size SMAll
IMAge size MEDium
IMAge size FULl
IMAge size JUMbo
ANTi-aliasing NONe
ANTi-aliasing GOOd

```
ANTi-aliasing BESt
TILt #
STArt
SKY NONe
SKY SOLid # # #
SKY GRAduated # # # # # #
GROund NONe
GROund SOLid # # #
GROund CHECKERED # # # # # #
GROund SCALE #
ILLumination # # #
ROTate CLockwise #
ROTate COunterclockwise #
WINdow North
WINdow South
WINdow East
WINdow West
WINdow Up
WINdow Down
GRAb
UNGrab
(#,#,#)
(#,#,#)-(#,#,#)
(#,#,#)-(#,#,#)-(#,#,#)
```

The various ADD commands take either one or two numeric values. The first value is the size of the object, expressed as half of its maximum width or height. Curved objects take a second value that must be a positive integer. For spheres and hemispheres, the value is the number of subdivisions, usually between 0 and 3. For the remaining curved objects, the second parameter is the number of divisions of the circle that generates the object.

The DO EXPAND command has a single numerical parameter that represents the expansion factor. If the number is less than one, a contraction is implied. The command may optionally be followed by the keywords NS, EW and UD. These stand for the north-south, east-west and up-down directions. If no keyword is specified, then the expansion is uniform in all directions. If one or more directions are specified, then the expansion is in the indicated directions.

The COLOR command, the SKY SOLID and the LAMPS COLOR command take three numerical values. These must be numbers in the range 0.0 to 1.0, and they represent values for red, green and blue respectively. The SKY GRADUATED command takes 6 values, the first three are red, green and blue values for the zenith and the second three are red green and blue values for the horizon. The number for the LAMP BRIGHTNESS command should be an integer.

The COORDINATES command invokes the coordinate window and accepts an integer in the range 0 to 9 that specifies the number of figures after the decimal point. This has the effect of scaling the number system that SCULPT 3-D uses.

The WINDOW commands have the same effect as clicking in one of the Tri-View windows. This is important if you use the ROTATE or DO SPIN commands, which rely upon the current window to control their operation.

The cursor may be positioned by specifying a location as three numbers separated by commas and enclosed in parentheses. The numbers are distances measured northward, westward and upward from the origin, or initial cursor position. Edges are constructed by specifying two locations separated by a minus sign. Multiple edges may be constructed. Vertices are automatically constructed at the endpoints of edges. Unlike the interactive mode of SCULPT 3-D, vertices are never created at the location of another vertex when operating from a script file.

GLOSSARY

CENTROID

The centroid of a set of vertices is the average of their individual positions. If the vertices all had the same mass, it would be their center of gravity.

CLICK

The expression 'click on a gadget', means that you are to point to the gadget and press down the left mouse button and then release it. If you press the button, and then decide that you want to change your mind, some gadgets permit the command to be cancelled by moving the pointer away from the gadget before releasing the button.

CURSOR

This is an object that represents a position in three dimensions, so it is displayed in all three Tri-View windows. It can be moved by the mouse, when the left button is pressed down.

DOUBLE CLICK

Because the mouse only has two buttons, you can signal the computer that you wish to do something special, by pressing a button twice in rapid succession. This is called double clicking, and it is almost always done with the left mouse button. You can use the Workbench Preferences tool to set the interval of time that the Amiga regards as 'rapid succession'. See the book "Introduction to Amiga" for more details. With SCULPT 3-D you should set the interval to be fairly short, so that a double click is a very deliberate act, rather than normal frenzied mouse activity.

DRAG BAR

This is a gadget that is located in the top border of each window of the Tri-View. It is used to move the window around on the screen.

EDGE

In SCULPT 3-D an edge is a line joining two vertices. An edge is visible as a dark line in the Tri-View, but edges are never seen in a picture.

EDGE BUILDING GADGET

This gadget resides in the lower left border of each Tri-View window. Its icon is a triangle. If two vertices are selected, then an edge will be constructed between the vertices. If three vertices are selected, then they will be joined by three new edges.

FACE

In SCULPT 3-D object are built from a patchwork of triangular faces. A face has a particular color and surface texture. A face is automatically created whenever three vertices are joined by three edges.

GADGETS

These are small images that can be used to perform an operation. Some gadgets are common to most Amiga programs while others are unique to SCULPT 3-D. The Tri-View has a number of gadgets in the borders of each window, that are used for changing the position and size of the Tri-View and for manipulating objects. Other gadgets appear in requesters. Most gadgets are operated by clicking on them with the left mouse button. Others, called sliders, are like the controls on a hi-fi graphic equalizer. You can click on the control knob and then slide it up and down, or from side to side, in order to adjust a value. Finally there are gadgets, that when selected by clicking, will enable you enter a name or a number from the keyboard.

HORIZON

The part of the sky that appears to be at ground level.

INDICATED VERTEX

If a vertex lies within a few pixels of the cursor in the active window of the Tri-View, this vertex is considered the indicated vertex. If more than one vertex meets this criteria and they are distributed in depth, then the indicated vertex is the one that is closest to the cursor in the depth direction.

OBSERVER

This entity embodies all the attributes required to specify the process of generating an image, including a viewing location, a target position, an imaging method and an image size. The width of view can be controlled by choosing a lens.

ORIGIN

The initial position of the cursor. If the coordinate window is displayed, the position of the cursor is specified relative to the origin.

PIXEL

A picture element on the screen. The Amiga can display 320 or 640 pixels in the horizontal direction and 200 or 400 pixels in the vertical direction. Subject to some restrictions, each pixel can be displayed in one of 4096 different colors.

POINTER

This is the image that moves on the screen when you move the mouse. The original Workbench disk pointer is an arrow but it can be changed using the Preferences tool.

REQUESTER

This is an object that appears on the screen from time to time, when SCULPT 3-D needs some extra information, or wants to be sure that you have received a message before continuing. Requesters contain gadgets that may be like push buttons, or sliders or even little boxes where you can type a short message. Whenever a requester pops up, you must acknowledge it by answering any questions and pressing the OK or CANCEL button with the left hand mouse button before continuing with SCULPT 3-D.

SCENE

A scene is one of the file formats used by SCULPT 3-D. It can contain objects, lamps, an observer and a world. In order to be recognized as a scene, the file name should end with '.image'. The command PROJECT SAVE IMAGE automatically adds this suffix.

SCRIPT

A file that contains commands that control SCULPT 3-D directly, rather than through mouse interaction.

SNAP

If the left mouse button is double clicked in a window, SCULPT 3-D looks for a nearby vertex (within about 3 pixels). If more than one pixel satisfies the criteria, then the one that is closest in the 'depth direction' of the window is chosen. The selection state of the vertex is toggled. Also the cursor is moved to the position of the vertex. This is called snap.

SWATCH

The patch of color at the lower center of one of the color requesters is called a swatch. It indicates the current color. Move the sliders to change the color.

TOGGLE

When a gadget has two different states that it can be in, and a single action causes it to change from one to another, it is said to toggle. For example some requesters have a box that may either contain the word YES or the word NO. Clicking on the gadget will change the gadget from YES to NO or vice versa.

TRI-VIEW

The set of three windows that are used for manipulating three dimensional objects. The Tri-View represents a block of three dimensional space, and only objects within that block are displayed. Objects are displayed as wire frame images.

VERTEX

This is a point in space that can define the end of an edge, or the corner of a face. In SCULPT 3-D, you manipulate an object by changing the position of one or more vertices.

VERTICES

The plural of vertex.

WINDOW

A portion of the screen that sometimes can be moved around or rearranged in depth. The most important windows in SCULPT 3-D are the three windows of the Tri-View. These windows have a blue and white border area containing a myriad of gadgets. The interior of the Tri-View windows are brown and contain a wire frame rendering of the contents of the Tri-View.

ZENITH

The point in the sky that is directly overhead.

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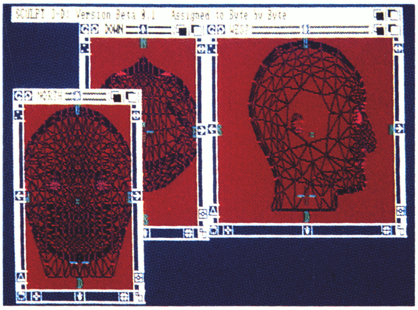
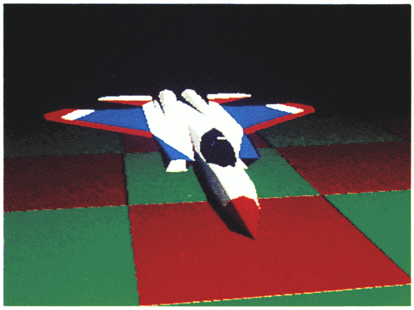
Create your own universe with Sculpt 3-D™



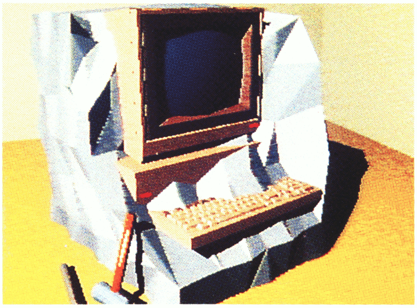
EASE OF USE

- Uses standard Amiga™ environment of mouse control, menus & windows
- Fully multi-tasking
- Wire frame edit mode
- Full library of graphics primitives
- Power tools like spin, grab, extrude, reflect and unslice



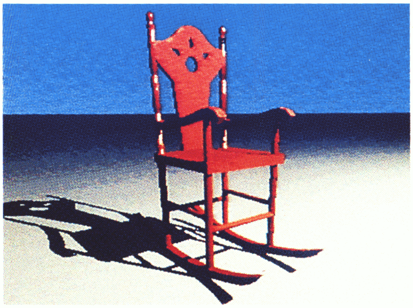
POWER

- Automatically handles shading, smoothing, anti-aliasing, shadows and texture
- Object files let you build your own libraries of primitives
- Overscan creates "true video" images
- Painting mode renders objects in seconds



CONTROL

- Complete control over the color, texture, smoothing and shading of every surface of every object
- Complete control of brightness, color and placement of multiple light sources
- Complete control over the camera position and angle of view



COMPATIBILITY

- All image files are IFF compatible
- Script file mode accepts ASCII input
- All resolution modes are supported
- Full support for video frame buffer boards and genlocks
- Not copy protected in any way, shape or form

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